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JULY 1956

35¢
IN U.S.A. AND CANADA

14 PAGE SPECIAL SECTION

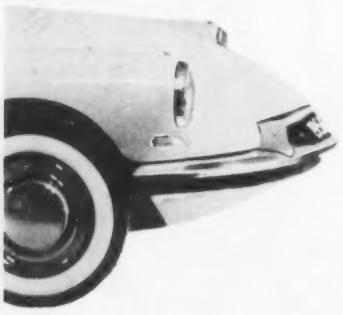
LIGHT CAR BUYERS' GUIDE

- specifications
- performance data

JUL 26 1956

Tech Report:

PBX Special



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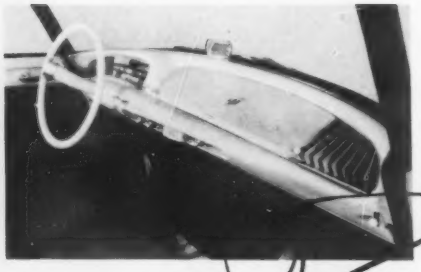

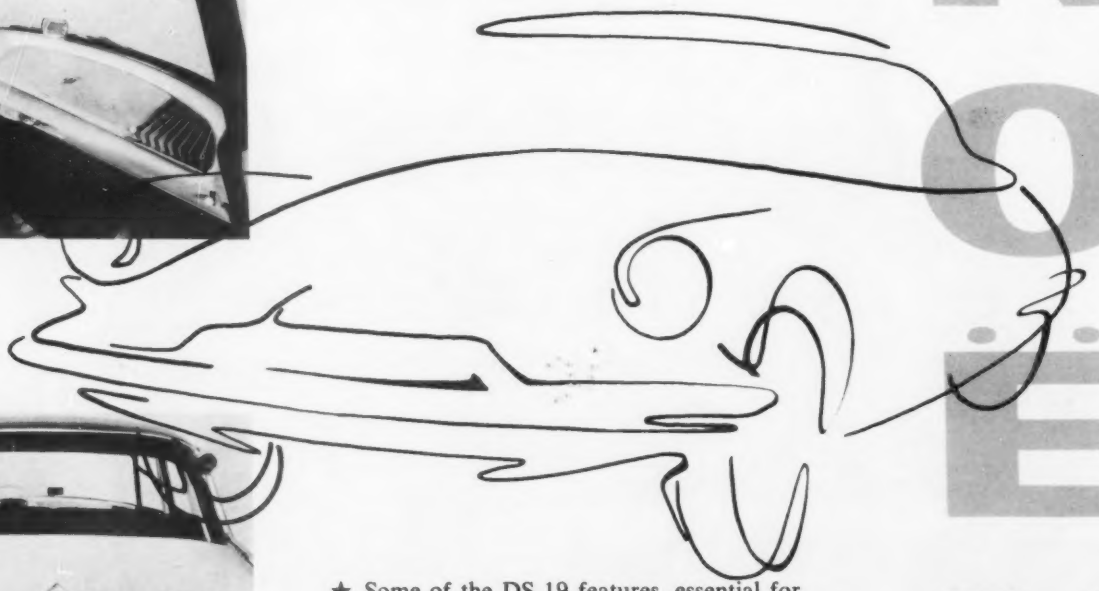

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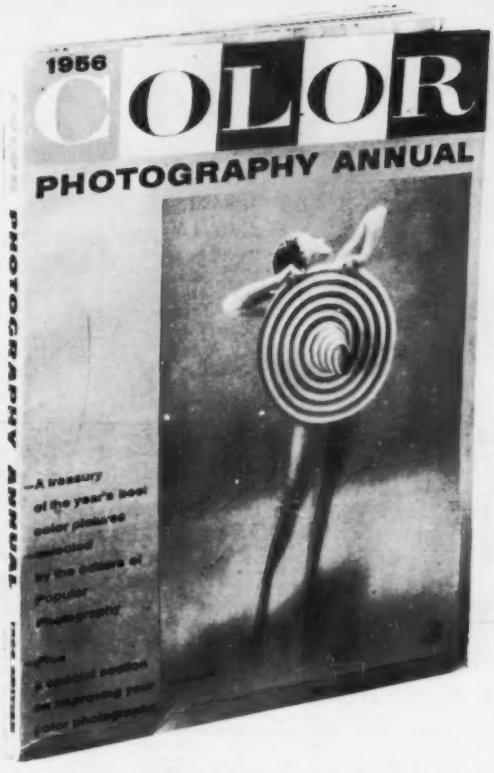

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SPORTS CARS ILLUSTRATED

july 1956
no. 1 vol. 2

This month's cover was designed by Art Editor Sid Greiff and photographed by Lester Bookbinder to introduce our Light Car Buyers' Guide, a special section beginning on page eight.

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very sincerely yours:

THE corner was a tight one, a sharp turn, leading from concrete to asphalt with a nasty little bump in the juncture between the two materials. As each car charged through, it slid sideways on the sandy concrete and then hopped to the outside as it hit the asphalt. Finally one car, a light little Lotus, ran out of road. Hitting the juncture a quartering blow it flipped, slid along for about ten feet upside down, slammed into a sand pile and came to rest. The driver was pinned inside, unhurt but thoroughly trapped. Just as the car was righted it burst into flame. There was no sign of a fire extinguisher on the corner, not even a bucket of water. A flagman grabbed the required extinguisher from the cockpit but the pitiful little trickle of carbon tetrachloride was sufficient only to release a cloud of choking phosgene as it hit the hot metal. Scratch one expensive automobile.

This little drama occurred last spring at Sebring. It points up a lesson that should be taken to heart by every car-owner, driver and race official connected with *any* form of competition. It's a lesson learned though bitter experience on the dry lakes and at Bonneville. The lesson is simply this: when it comes to a gasoline or alcohol fire in a race car a carbon-tet fire extinguisher is worse than useless. The small units usually carried don't pack enough juice to cope with such a fire. Worse, the fumes released by carbon tetrachloride in contact with heated metal are deadly poison – a World War I gas known as phosgene. A driver trapped or pinned in a burning car could, perhaps, hold back a fire with a liquid extinguisher for a short while only to be gassed in the process. It could have happened at Sebring; it didn't because help was immediately available.

The answer, learned at Bonneville, Muroc and El Mirage, is simple: Carbon dioxide – CO_2. In the past few years CO_2 extinguishers have been standard equipment on every corner in all West Coast road races, at several points along all drag strips and at strategic points along the courses at Bonneville and El Mirage. Further, the smaller, five-pound units are required equipment in the competing cars. It is difficult to say just how many lives and how many dollars worth of equipment have been saved by these simple precautions but just one life is worth any trouble necessary to save it. The above is not meant to say that the carbon-tet extinguisher is useless in all cases – it isn't. Carbon-tet is excellent for small, open-air fires or blazes in places that can be evacuated immediately. However, as far as we are concerned, carbon-tet has no place in a race car except as a cleaning fluid.

* * *

In the past few months we have received literally hundreds of requests for information on "specials" – the backyard boomers we featured briefly in the April issue. Starting on page 32 is our first offering – one of the hottest small-bore specials ever built in anybody's backyard, Candy Poole's PBX. Karl Ludvigsen has torn the little bomb apart nut by bolt and, on the center spread, SCI's cutaway genius, C. O. LaTourette, has laid bare the bones.

* * *

Regarding the fourteen pages starting with page eight, we need make little comment. This is one of the most exhaustive pieces of research ever done in one jolt on the light, economy car trend. SCI's research staff drove every car mentioned but one and that one hadn't reached the U.S. as of presstime. This guide is no publicity pickup but a series of true SCI capsule road tests of each car mentioned. We have made no attempt to compare the cars but have evaluated each according to its individual merits. The reader as the prospective buyer can make the final evaluation and comparison according to his individual needs. We don't feel that it is incumbent on us to tell you *what* to buy but merely to present a handy guide to aid you in your choice, be it a 90 mph Volvo, a go-anywhere VW or that most minimum of cars, the 2CV Citroen. We've presented the facts and figures – *you* make the choice.

–john christy

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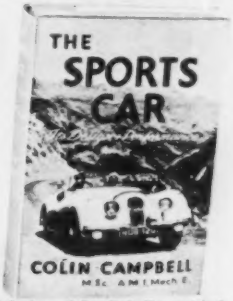

You learn about the latest models, but the subject matter is treated in such a way that THE SPORTS CAR: Its Design and Performance will not be out of date when next year's models appear, or–the year after that! Discusses MG, Jaguar, Aston-Martin, Mercedes-Benz, Lagonda, Lancia, Morgan, etc. The Technical Correspondence Editor, January issue, ROAD AND TRACK, in reply to a request for a good reference book on suspension and chassis design said: ". . . . . By far the best book is THE SPORTS CAR: ITS DESIGN AND PERFORMANCE by Colin Campbell . . ." Check it yourself, chapter by chapter.

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letters

test or conjecture?

Dear Sir:

I was very much interested in your road test of the Karmann-Ghia Volkswagen Coupe in the April issue, especially since a test of the same model appeared in a competitive magazine for April. Now I am puzzled! In their test the figures are anywhere from 10%-25% better than those quoted in your report. For example:

	SCI	*Comp.*
Engine torque at 2,000 rpm	45	56
Acceleration to 60 mph	35.5	28.8
Standing ¼ mile	23.8	23.6
Best run	69 mph	76 mph

Readers of magazine road tests are used to slight discrepancies in test results, but when it comes to a matter of top speed, acceleration to 60 mph, and engine torque, these figures are too far apart. One of you must be wrong, or should the reader take his pick and let it go at that?

Very truly yours,
Charles Silversmith
Boston, Massachusetts

We have yet to see a stock VW of any description that will crank up to 60 from a standing start in much under 35 seconds. The Karmann-Ghia is no exception, particularly since the car weighs considerably more than a standard model. Torque figures are those supplied by the factory. The torque figure of 56 lbs-ft. is slightly ridiculous, all factors considered. Since SCI has no axes to grind, we cannot afford optimistic conjecture if only for the fact that the manufacturer would be the first to complain. We can vouch for our own tests only. — Ed.

ride appreciated

Dear Sir:

With humble heart I can only say "Thank You" for the "ride" in your Mercedes-Benz 300SL (April '56 issue).

Each of us has our dreams and wishes. Some want a million (tax free) dollars, others want big homes, some want yachts, — I'd be very, very happy with a 300 SL.

At 25, I am *not* a sports car fan — don't even have a subscription to any sports car magazine. I do however have a boss that owns a TR-2 and have consequently garnered much information about this wonderful sport. As a married radio-announcer/engineer, with a two year old son, another child on the "assembly line" and a newly bought

home, there is very little chance that I shall ever own a 300 SL. There is less chance that I shall ever touch one or (deep sigh) drive one.

Which brings me to the point of this letter; Never have I enjoyed an article more than Mr. Borgeson's concerning the 300 SL. Not only was it completely educational in scope, but a pleasure to feel yourself get in, snap the gull-wings down and take off down the pike like the "proverbial bat." After the description of the ride in the Standard 300 SL, my stomach had the feeling we've all experienced after our first kiss. (I'm flyin' man, – flyin'!!) I'd like to go him one better in saying that this car is the epitome of the automotive world; in my estimation the world's finest car for sport and pleasure.

There is one factor though that scares me somewhat. If by some stroke of luck or chance I suddenly become the proud possessor of one of these fine machines, will I fit??? I stand six feet, six inches!!! Can I squeeze my long frame into this bomb???

(We-e-e-l-l-l, sure. – Ed.)

Again, thanks a million for the lift. Now that I'm back on the ground I wonder if SCI ever plans on any driving tests of the Mercedes-Benz 190? Though I know less of this car than its bigger more powerful brother, I'm sure the Mercedes-Benz people have scored again.

A satisfied reader,
Jack W. Schaefer
Sturgeon Bay, Wisconsin

help wanted

Dear Sir:

I have been reading your magazine for the past seven months while I have been in the hospital with a broken back. I like sports cars and pictures of sports cars and am endeavoring to build up a collection of pictures as a means of entertainment while bedridden. Any photos that you or your readers could send along would be greatly appreciated. My home address is 3434 Sheridan Avenue, Butte, Montana.

Sincerely yours,
Jack G. King

brakes

Dear Sir:

From your specification of the 300 SLR, it states that the rear axle is of the swing axle type. This would not be probable using the brake drum arrangement shown on p. 35 of Sports Cars Illustrated.

Very truly yours,
A. O. Wall, Jr.

In the swing axle set up brakes can be inboard or outboard, even with the low pivot-point used on the SLR. – Ed.

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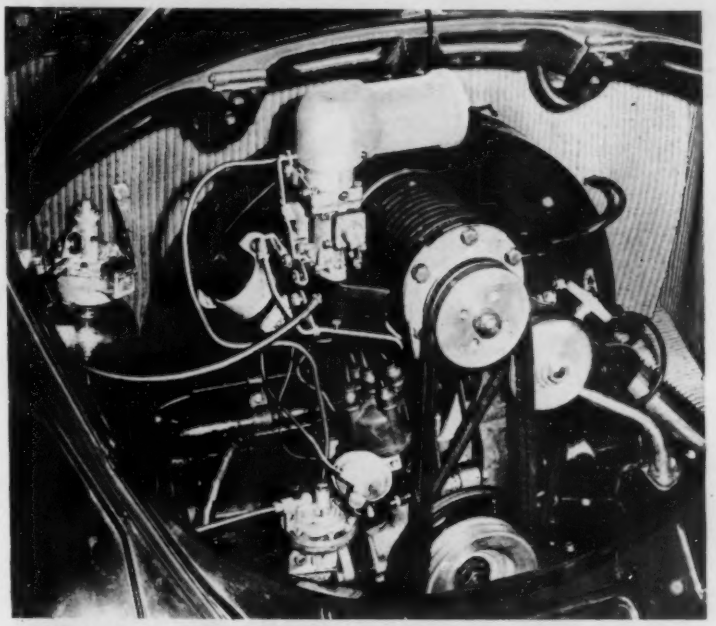

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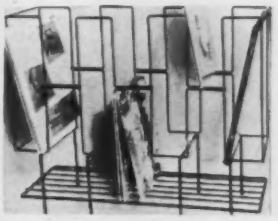

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Buyers' Guide to the Light Cars

Rebellion against the spiralling costs of operating the modern car has caused a boom in light car sales. Here are 17 of the newest.

An SCI Staff Report

RECENTLY George Romney, president of American Motors, announced bluntly to the public that all U.S. cars — his own company's included — are far too big. In spite of the current passion for bigger, fatter, more obscenely overhung machines, the industry, he said, will sooner or later have to start building cars of more rational dimensions.

Apparently plenty of Americans are ready to agree with Mr. Romney. The biggest news in car merchandising today is the enormous success of the mass invasion of European light cars. Nearly every light car made overseas is now being imported into the U.S., and the demand is still way ahead of the supply. For this survey we inspected and drove every foreign light car being sold on the West Coast, and almost all the distributors told us that their biggest problem is getting enough cars. One said, "The manufacturers over there can't believe we need as many as we say we do. They have no conception of the American market; the demand here is far beyond their wildest hopes."

The light-car missionary in the U.S. market has, of course, been the Volkswagen. The VW proved to Americans that they could buy reliable, comfortable transportation for

a fraction of the initial and operating cost of the big Detroit barges.

And it proved a lot more. VW buyers soon learned that the car's fantastic economy is only one of its charms. They discovered that a short-wheelbase light car can effortlessly outcorner any large machine — that it's easy to steer, because there's so little weight on its front wheels that it can use fast sports-type steering — that it can be parked in one-half to two-thirds the space required by a conventional U.S. machine — that it's far more agile in traffic and mountain driving and a perfectly satisfactory tourer on long highway trips. And they discovered that a light car with snug all-weather body is just as much fun to drive as a sportier open two-seater.

The average VW buyer is more than a consumer. He's a convert. He tells his friends that he'll never go back to feeding and herding a car that weighs a good ton more than it needs to, and he boasts about the virtues of light-car ownership. Maybe his friends would never consider buying a sports car, but when he talks about comfort, safety, economy — they listen. And the market grows. In the past few months VW has outsold many U.S. makes in various parts of the country.

American businessmen, always sensitive to new consumer wants, have watched the VW phenomenon with fascination, and are now urgently acting upon its lesson. The result is that now, in the summer of 1956, that new breed of driver, the American light-car enthusiast, has never had it so good. His custom is courted by importers of nearly every good foreign light car. Some of the cars come from countries so eager for solid U.S. currency that they sell more cheaply here than at home. The choice of cars now available here is broader than in any single European country and it includes chassis and bodies that range from traditional to diminutive-Detroit to really radical.

On the following pages is a capsule analysis of each of the light cars currently available in the U.S. in significant numbers. It's a fascinating display. Look it over and you'll soon see why there's a light-car revolution going on in the U.S. today.

ALFA ROMEO GIULIETTA

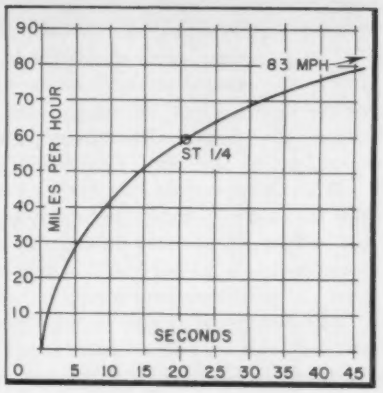
THE basic four-door Giulietta is the costliest light car in this roundup of the field. Even though it's Alfa's most inexpensive touring machine, it can't be classed as an economy car on grounds of first cost. It can be operated for nickels and dimes, but actually you don't buy the Giulietta for its fuel economy.

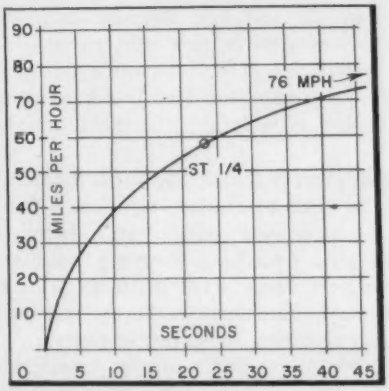
You have to be a special sort of enthusiast to pay a big-car price for this machine. You have to prize its competition-quality chassis, its superb brakes, its precise ZF steering, and its beautiful, smooth and efficient dual overhead camshaft engine. If you're a student of racing engines and chassis, chances are that nothing else in the light-car field will appeal to you as much.

The mass-produced Giulietta four-door is a scaled-down version of the fleet, formidable, safe and costlier 1900 T.I. Alfa. The unit-construction principle is the same in both cars, and the engines are basically alike, although the 1300's carburetion puts more emphasis on fuel economy. The Giulietta has huge, deeply-ribbed aluminum drum brakes, and coil spring suspension all around. Its rear axle is set up like a racing car's, with rugged radius arms and A-frame on the final drive housing to maintain perfect suspension geometry under *all* operating conditions.

Although this "economy" Giulietta develops peak power at 5200 rpm – the hotter Sprint models cost more – its engine is still loafing at this speed and gives the impression that it's barely stressed. For acceleration and top speed the 1300 stands among the leaders in this survey. But there's much more to it than mere straightaway "go." In roadholding, steering and brakes, the Giulietta stands aloof, hardly to be compared with any other machine in its class.

The car's body is sober and conservative, somewhere between the plain and the distinguished. Luggage room is excellent, front-leg room good, rear-seat leg room minimal. The interior of the body is surprisingly austere and suggests that the four-door is made primarily for the home market. There are now large parts depots for the car on the east and west coasts, and the dealer organization is growing in proportion to the increasing supply of the little thoroughbreds from Milan.





AUSTIN A50 CAMBRIDGE

IN many ways this is the best medium-sized Austin ever built. For roominess, comfort, style, performance and responsive, easy-to-use controls, it represents big improvement over its popular ancestor, the A40 Somerset.

There's nothing of the "baby car" about this machine's appearance, and when you're inside it has a definite big-car feel. Although it's fundamentally a four-passenger car, the adjustable, divided bench-type front seat can be aligned to carry three riders of average size in comfort; the rear seat is wide enough for three more. The upholstery is of leather and vinyl over firm foam rubber and gives fine support for long trips.

The four-door Cambridge is an interesting blend of the requirements of stylish and utilitarian motoring. Its interior is both attractive and ruggedly durable. The instrument panel is well-equipped and good looking, and below it a spacious and very useful shelf runs the full width of the body. The volume of luggage space at the rear is so big it's startling. It's achieved partly by stowage of the spare wheel under the body at the rear of the car

The A50 is unlike traditional light cars as much for its performance as for its roominess and big-car finish and feel. Its husky ohv engine is geared to provide strong, positive pulling power throughout the car's speed range. Sufficient torque is delivered to the rear wheels so that First gear needn't be used in getting away from a full stop. Top-gear torque results in surprising hill-climbing and traffic flexibility and the rate of acceleration remains fairly lively right out to the far limit of the A50's top speed.

It's an easy car to drive. Hydraulic assist makes the clutch action nearly effortless, the steering is very light and quick, the gear change mechanism is smoother than in previous Austins, and the bigger-than-before brakes are easier to apply.

The A50 Cambridge is a well-finished low priced car that carries a 90-day/4000-mile guarantee backed up by one of the biggest foreign-car sales and service organizations in the U.S.

BORGWARD ISABELLA

ONE of the star performers in under-1500 production car competition recently has been this new import from Germany. In "Touring Sports" tune its well-laid-out little ohv four-cylinder engine puts out 75 bhp and the standard model develops 60. These output figures are measured by the DIN method, which duplicates the actual car installation on the test bed. Therefore the Borgward engine is probably even more lusty by SAE standards than it's claimed to be.

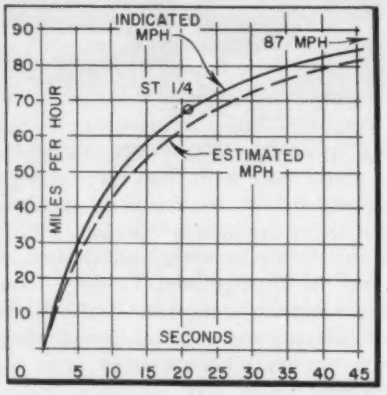
The first five minutes spent behind the wheel of either of the 1500 cc Borgwards are pretty startling. The standard model rockets from zero to an indicated 30 mph in 5.8 seconds and from rest to indicated 60 in 15.3. It cruises contentedly at 80. Driving this car is totally unlike the tepid experience of tooling the meagerly powered light cars typical of the recent past.

The Borgward performs vividly under all conditions, a fact abetted by four-wheel independent suspension, fast steering and syncromesh on all four gearbox speeds. The gears are cleverly chosen, the numerically low final drive ratio permitting high top speeds while the intermediate gearbox ratios supply degrees of pulling power to meet all requirements.

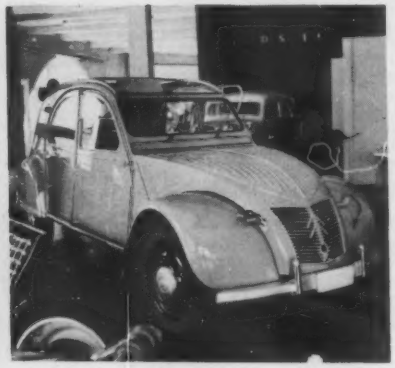
The *full*-syncromesh transmission and hydraulically assisted clutch are intensely pleasant to use because of the silent precision with which up or down shifts can be made. The engine has a well-knit "sewing machine" sound, and although it pulls powerfully, it transmits almost no vibration to the body throughout the speed range.

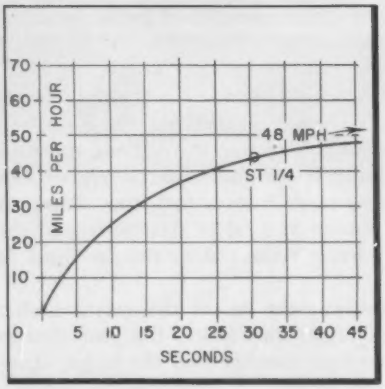
From its porcelain-like body finish to its spic-and-span engine space, the Isabella is a luxury light car, as well as being one of the very quickest in its field. It's also among the leaders in terms of spaciousness. The luggage space is huge and very few light cars can match it for front and back-seat knee and leg room.

The Borgward is one of the most recent newcomers to the U.S., but its thorough excellence has made it accepted on sight. There are now more than 50 Borgward dealers in the Los Angeles area alone, the dealer and service organization is growing nationally, and there is a several years' stock of parts already in the U.S. The Borgward's American future looks very bright.



CITROEN 2CV





THERE *is* a poor man's VW and this is it. The first reaction of Americans to this unbeautiful vehicle is no different than that of the style-conscious French, who were appalled when the slab-sided sub-flivver made its public bow. But the 2CV's designers deserved and got the last laugh.

Used 2CV's are so cherished in France today that they bring premium prices, have the lowest depreciation of any car. Their fame has spread throughout the world and is greatest where road conditions are worst. The 2CV has the go-anywhere abilities and ruggedness of a bulldozer, the smooth ride of a luxury car, the fuel economy of a two-stroke lawn mower. Give the car a brief try and you won't laugh at it again.

The 2CV was originally designed to meet the transportation needs of low-income rustics who perhaps had never driven a car before and could afford to spend less than little on operation and upkeep. Citroen's answer to the requirements is an engineering *tour de force.*

In spite of its harsh external appearance the 2CV has one of the most amazingly comfortable rides in the industry. Because extreme vertical wheel travel plays an important part in this ride, there is a good deal of body roll. Still the front-drive 2CV is an outstandingly roadable car. Its steering is by rack and pinion and famous for its precision. Its braking power is massive and reliable, and its synchromesh transmission is smooth and precise.

Every design detail of the car shows great ingenuity, and this includes the tiny but robust power plant. The little air-cooled engine is a flat-opposed twin in which light alloy is widely used and aircraft influences are apparent. In spite of high potential breathing efficiency possible with hemispherical combustion chambers, these seem to be exploited in the 2CV solely for their good thermal characteristics. In the interest of long life, the engine is deliberately throttled in its intake ports.

Right now every effort is being made to get 2CV's on the American road. This includes a current cut-rate price for the standard model of $995, which may be increased at any time.

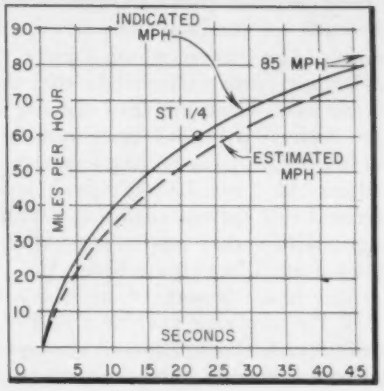
DKW 3 = 6

YOU can't begin to imagine the DKW's phenomenal cornering ability until you've put it to every possible test yourself. Then you agree with the factory literature, which says blandly, "your DKW will always stick to the road as long as you keep your foot on the accelerator pedal, no matter whether you are driving through sharp bends and corners or on slippery or icy surfaces." This sticking power is beyond the experience of anyone with a background of unalloyed Detroit iron, but it is only one of the front drive DKW's many remarkable features.

Others are its sudden wheel-spinning acceleration and high speed, both derived from a tiny, simple, durable engine. The three-cylinder 54.6 cu. in. engine is built on the two-stroke principle, as DKW motorcycle engines have been for decades. Hence the 3 = 6; the DKW three delivers the same number of power impulses per crankshaft turn as a four-stroke six. The two-stroke engine does more than conserve space and weight. It has no camshaft, no valves, no tappets, no conventional distributor or fuel pump. In fact, the engine is claimed to have only seven moving parts. These are made as friction-free as possible. The main bearings, for example, run in ball races and the con-rod lower ends on double-row needle bearings. Aside from its typical two-stroke throb at idle, the engine revs with silken smoothness. The object of its studied simplicity, of course, is to keep maintenance costs at a real minimum.

An attractive and very roomy line of body styles is being imported and all have that slick, super-professional finish at which the Germans excel. Auto Union, maker of DKW cars, has matched or surpassed its competition in eye-appeal, comfort, payload-space and, of course, performance. The DKW *wants* to be driven like a sports car, does very well in production-car races, and can really maintain high average speeds.

From the parts and service standpoint, the DKW picture in the U.S. is good. The dealer organization is large at this writing and still growing. Although it's a new comer, the car is a quality product and there's nothing else quite like it.



DYNA PANHARD

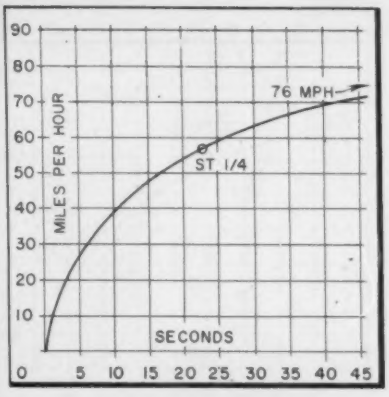
THIS is one of the best-engineered, most imaginative cars being built anywhere in the world today. It's also one of the most significant. The Dyna Panhard stands as a yardstick for measuring the efficiency of other cars, a model for today's and tomorrow's engineers to study and profit by.

It is not an inexpensive car to buy, particularly if you look for a direct relation between cubic inches and cost. But it is almost ludicrously economical to operate. If you want to nurse it along you can probably get 60 to 70 miles per gallon. But like the Alfa Giulietta, you don't buy this car for its fuel economy alone. In spite of its tiny engine, it's a very fast car – so fast that a list of its racing successes, including five years straight at Le Mans, would more than fill this page.

The Dyna is a big car by light-car standards. It has plenty of room for six passengers and lots of luggage, yet it's very light. Its ready-to-go weight of under 1600 lbs. is achieved by the most extensive possible use of light alloy in body panels, chassis and engine. It is the closest approach yet to an "all-aluminum car."

The shape of the Dyna's body is the result of a long series of aerodynamic experiments with scale models in wind tunnels and with full-scale prototypes on the road. Its wind drag is perhaps the lowest in the entire touring car field, and this, of course, has an important effect on its performance and fuel economy. Just as a penny saved equals a penny earned, minimum weight and wind drag equal horsepower. In the case of the Dyna, they enable a 52 cu. in. engine to give the car speeds and acceleration that cars with much larger and more powerful engines can't begin to match.

The Dyna's engine is a sort of engineering feat in itself. It amounts to a fine, light-weight, compact aircraft engine, and as such has a strong appeal for the advanced engineering fan. It's an opposed four-stroke air-cooled twin with light alloy cylinders and integral heads. A clue to its originality throughout is the fact that it uses torsion bar valve springs! It's just not possible to do justice to this car in anything less than a fat feature article. All we can say here is that it's a car for the connoisseur, with all the efficiency, economy and road behavior that this implies.



ENGLISH FORD

THERE are many reasons why the American light-car shopper shouldn't fail to give a careful once over to the British Fords. One reason is the variety of dimensions, body styles and power plants available in the line. Another is ease of service and maintenance. All the British Ford engines and chassis are scaled-down versions of U.S. Ford machinery and therefore present no mysteries to U.S. mechanics. They all use U.S. bolt, nut and thread sizes throughout and require no foreign tools. Another factor that's important to some buyers is the styling of the British Fords. They have an authentic American look and are very much at home on the U.S. scene. They should be, since they are actually designed in Detroit.

But these practical considerations are only part of the story. All the English Fords are excellent light cars and can hold their own with the competition. The biggest reason they're not regularly stocked by vendors of Detroit Fords may well be that they are less expensive and in many ways more satisfying than the big Detroit machines, and could cost the dealers' principal stock-in-trade a lot of sales.

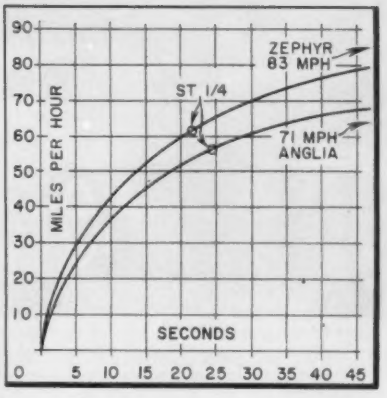
All of the English Fords have compact wheelbases; some are shorter than others. All have Lancia-type independent front suspension by huge vertical coil springs enclosing tubular shock absorbers. All have handling qualities that are sure to be the envy of a discriminating herder of a normal Detroit machine.

These cars have the sort of steering you expect to find on a good sports job. You can take your hands off the steering wheel when crossing streetcar tracks diagonally and the car continues to go exactly where you originally aimed it. This unusual steadiness of the steering holds true even during hard braking; with your hands off the wheel the car tracks perfectly straight. These cars offer a remarkable combination of utility car, Detroit car and sports car features.

The Anglia and Prefect are closely similar varieties of the English Ford, both powered by a vigorous 71.5 cu. in., in-line four with side valves. This engine is no more – or less – than the immortal Model A Ford power unit refined and brought up to date. Its vitality will thoroughly surprise you.

The Consul is a very similar car with one big difference: its greater urge is derived from a neat little ohv four with 92 cu. ins. displacement. It will thrust you from A to B faster and in greater safety than several other cars selling for an equal or greater price. "Mark II" Consuls with engines enlarged to 104 cu. ins. are expected to start reaching the U.S. this fall.

The Zephyr, next step up in the Ford line, has an in-line six-cylinder engine with the same bore and stroke as the Consul. It also has a slightly longer wheelbase. The power plant closely resembles the U.S. Ford six and presents merely a routine challenge to any mechanic familiar with Ford products. Its top speed is in the 80-mph range, but it's geared to get there fast. Like the Consul, the Zephyr's engine has just been enlarged for the English market. Displacement is up from 138 to 156 cu. ins., and the big-engined version should be available here within a few months. The Zodiac, a de luxe version of the Zephyr, offers special finish, a number of bolt-on extras, a higher compression ratio and more urgent throttle response.



Finally, the British Ford line includes a pair of diminutive and thoroughly delightful station wagons. The Escort and Squire wagons are very roomy scaled-down replicas of the American-style variety. At $1600 and $1700 (P.O.E.), they are among the most desirable items in the inventory of Ford's Foreign Products Division.

The U.S. currently has a stockpile of more than a million dollars worth of English Ford parts, readily available to any Ford dealer as well as to foreign car dealers and garages. U.S. owners who prefer to do their own maintenance work can get splendidly detailed shop manuals printed in English.

HILLMAN MINX AND HUSKY

THE Rootes Group, one of England's Big Three, builds the Sunbeam, Humber, Rover, Singer, and Comer trucks, but its main source of income is the Hillman, loved and respected around the world.

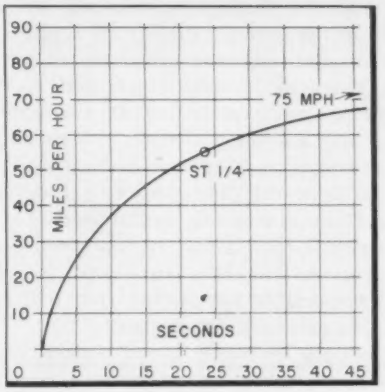
The product philosophy that has made the Rootes' Hillman a best seller is a foolproof formula: start with a good solid product, then maintain it in a state of vigorous evolution and detailed refinement. Every new Hillman model has been a distinct improvement over the last, yet the character of the marque has remained stable for over 20 years. Hillmans have never been radical, just progressive.

The Minx has kept pace nicely with the world's changing style requirements. There is now nothing specifically "British" about its looks; its styling is U.S.-inspired international-modern. Last year the export version of the Minx got a brand new short stroke ohv engine to replace the completely reliable but less efficient, less powerful side-valve four that still powers the Husky and the minimum-priced Minx, not available here.

The ohv engine makes the Minx a decidedly livelier car with little effect on its fuel consumption. Steering, brakes and general handling qualities are up to good short-wheelbase standards, and this is the best riding, best cornering Minx to date. While most column shifts for four-speed gearboxes are anything but smooth, the Hillman mechanism is silky when properly adjusted. Top gear pulling power is strong from below 15 mph and the car cruises well at an indicated 65 mph. First gear isn't necessary for starts from standstill.

The Husky, Hillman's pinmoney station wagon, seats four; the front riders have form-fitting bucket seats. This is a completely honest piece of merchandise, a comfortable, solidly-built little workhorse with a simple, willing engine that buzzes away happily under the worst loads.

Hillman has the light car market well covered with this roomy, utilitarian wagon and with the snappy, beautifully finished Minx sedan, convertible and hardtop convertible. Rootes' dealer and service organization in the U.S. is one of the very best and there is no danger of a shortage of replacement parts.



METROPOLITAN

IN January of 1950 a prototype called the Nash Experimental International, or NXI, was exposed to the American buying public in a series of shows across the country. Consumer response was generally confined to reserved interest, but Nash ultimately decided to take the plunge and mass-produce a 2-3 seater light car specifically intended for Yankee consumption. And so the Metropolitan appeared in the spring of '54.

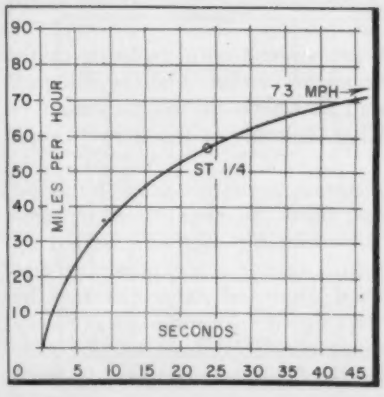
Viewed in the light of the VW boom, it's obvious that Nash's timing was perfect. However, the Metropolitan failed to cause a sales stampede at all comparable with the VW's. The obvious reason for this (though not necessarily the correct one) was the VW's better passenger capacity.

This may be corrected in the updated version of the Metropolitan, which is due for public introduction as we go to press. There will be few changes beneath the body sheet metal but the car's external aspect will be revised to reflect consumer preferences observed during the Metropolitan's brief but educational life span. Naturally, the new model will be an improvement upon the first bold assay by a U.S. manufacturer into the really *light* light-car field.

The Metropolitan is a British-built car designed to meet American requirements, as set down by the Nash division of American Motors. Its engine and running gear are rugged, perfectly proved components supplied by the Austin branch of BMC, Britain's colossus of the automotive industry. The unit-construction bodies for the Metropolitan are also made in England according to the American-Italian specifications of Nash.

The current Metropolitan has few defects in the light-car frame of reference. The most serious gripes registered by owners, aside from seating capacity, concern the excessively large turning circle and the somewhat inaccessible luggage space. Otherwise the Metropolitan goes, stops, steers, handles and rides well. Its fuel economy is excellent and its top speed and acceleration are adequate. The parts and service problem is minimal.

This home-industry experiment deserves support and success. It might be well to check the new Metropolitan before you buy.



MG MAGNETTE

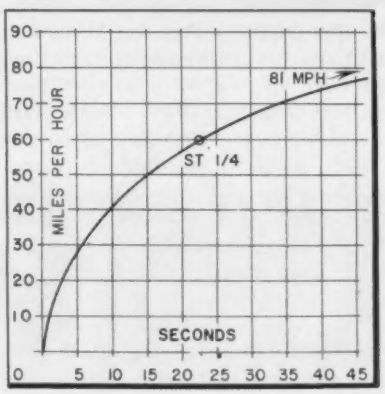
YOU might not expect the conservatively chic Magnette to be a controversial car, but it is – and all because of its name. In pre-war days MG Magnettes were fire-breathing two-seaters that made racing history, and diehard aficionados feel that MG ought to have saved the name for a car of similar temperament.

Because if there's one thing the new Magnette *isn't*, it's fierce. What it *is* is a luxurious machine for the sports car fan who has a family to shield from the elements, and an aristocratic tourer for those whose Rolls-Royce taste survives in a difficult atmosphere. The Magnette is *the* quality car in the light-car field.

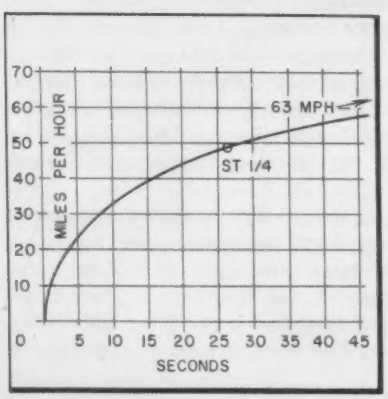
You have to look hard for defects in this car. About the harshest comment you can make is that space for the throttle pedal is cramped. Otherwise, the Magnette is a study in traditional perfection. It retains a positively-acting floor shift. Its dial-studded instrument panel is made of finely-finished walnut burl and the door-trim panels and even the windshield molding are of fine hardwood. It has excellent bucket seats, even though there would be more room with a bench-type front seat. These and the three-place rear seat are finished in pleated, natural leather. In the best old quality-car tradition, the car comes with a huge set of tools and a six-month/8000 mile warranty.

The Magnette handles, steers and accelerates as products with the MG marque are expected to. Its twin-carburetor engine is quiet, free-revving and a vivid performer. Its roadholding abilities are excellent and its suspension transforms kidney-bruising bumps into gentle oscillations. Its floor-shift transmission is a delight to use, as are its precise rack and pinion steering, hydraulic clutch and two-leading-shoe brakes. Its top gear torque is fine, its top speed is on a par with leaders in the light-car class. The Magnette, then, is a family-type car with a thoroughly respectable appearance that still has a strong sports car character and a great deal of elegance.

MG is made by Nuffield, and Nuffield is a branch of the giant British Motors Corporation. Therefore the U.S. parts situation is excellent and the Magnette is a sound investment for the sports car devotee who has family transportation on his mind.



MORRIS MINOR



THE Morris Minor is a distinguished car in a number of ways. It has the smallest engine of any British touring car, gets the best gas mileage, and is one of the cheapest cars in the world. Still, it's built to such good standards of quality that its manufacturer – the Nuffield-Austin BMC combine – backs it up with a six-month/8000 mile warranty. In the sense of quality required to do its job reliably and well, there's nothing cheap about the Minor.

It carries four adults in excellent comfort. Admittedly, foot room for the forward passengers is restricted by intruding wheel wells, but this is compensated for by good bucket seats. The four-door, unit-construction body is built to last. Its finish, for example, consists of a rust-proof dip, four coats of primer and two of baked enamel. Torsion-bar front suspension contributes to a luxurious ride even over bad roads and rack and pinion steering adds to the Minor's precise controllability. And this, like the Magnette, is one of the few touring cars left in the world with a good, positive floor shift.

The gearbox is a pleasure to use, the severest criticism being that a longer-winding Third gear would be mighty useful. The car will pull away from a full stop in Second, spin its wheels on wet pavement in First, cruise all day at 50 mph and lug smoothly at less than 10 mph in top gear.

Morris Minor performance hasn't always been this good, but after the Nuffield-Austin merger, its former side-valve engine was replaced by a more efficient, more powerful ohv Austin power unit beefed up with an oversize S.U. carb. This fine little engine was exploited to add slightly to the Minor's top speed, and improved its acceleration by about 30 percent with no adverse effect on fuel consumption.

The wiry, fuel-stretching little Minor comes in three touring-body styles, two-door and four-door sedans and a two-door convertible. Each of these has a luggage compartment with seven cubic feet of very useful space. Also there's a smart-looking little station wagon that has seats for four and great cargo capacity.

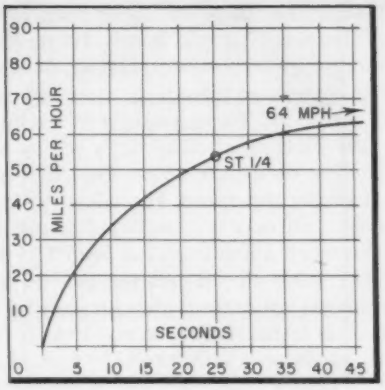
RENAULT 4CV and DAUPHINE

THE *Quatre Chevaux* Renault is hardly a traditional type of automobile, but its engineering is conservative. Its rear-mounted engine is a very standard water-cooled, in-line, ohv four with a pretty little "bunch of bananas" exhaust manifold that would look at home on a Brescia Bugatti. It's designed for the minimum-budget motorist but this does not mean that it's a minimum-performance car. In fact, the spunky little 4CV has a long and distinguished racing record and it's easy to see why the first time you take it around a city block.

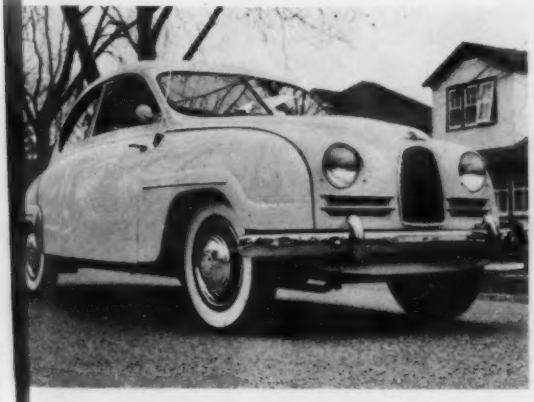
It accelerates like the famous scalded cat, winding out to 20 mph in First and 50 in the middle cog of its three-speed, floor shift box. It has the cornering agility of a unicycle and can be through a turn and down the straight while a bigger car is just beginning to coax its wheelbase around the bend. It has thoroughbred rack and pinion steering and its makers have a good deal of justification in saying that no car in the world is so easy to drive. One thing for sure, driving it is a revelation. You wouldn't believe that such a baby could be so roadworthy, so stimulating to drive.

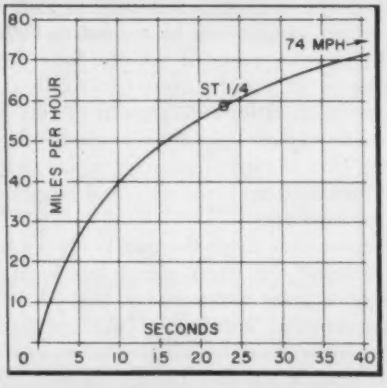
It's small, all right. There is room for four in the car and that is absolutely all. Luggage space under the hood at the front of the car exists, but barely. But there are plenty of motorists for whom the 4CV is ideal. We've talked to some, and they're completely dedicated to the car.

But the 4CV *is* too small to fend off much of its sales competition in the light car field. Renault has plugged this gap in its market coverage with the brand new Dauphine or 5CV model. Mechanically the Dauphine is a slightly scaled-up and more refined version of the baby Renault. The big differences between the two cars are in passenger and luggage space, style and performance. The Dauphine retains bucket seats in front, but three can ride in comfort in the rear. Four doors are retained, along with a luggage compartment at the front end, but this now has a capacity of seven cubic feet as against the one shopping-bag capacity of the 4CV. The Dauphine's body is well streamlined in favor of both fuel economy and speed. Newest product of one of the world's oldest car manufacturers, the 5CV has to be good.



SAAB 93





THE SAAB 93 designed and built by the famed jet aircraft firm, Svenska Aeroplan Aktiebolaget (SAAB) is the first car produced by this company to be presented to the American market. Delivered price including radio and heater is $1795.00.

Within its unit body and frame construction, the SAAB 93 seats four people in moderate comfort, provided the passengers relegated to the back seat are not overly lanky. It is primarily an economy car, and with moderate handling should give its owner between 30 and 35 mpg.

The three cylinder, two stroke engine has an output of 38 hp at 5000 rpm and maximum torque of 52.1 lb/ft at 2000 rpm. While these figures seem staggeringly unimpressive by present-home-machinery standards, they are more than sufficient to give the little SAAB spirited acceleration through all the gears.

A unique combination of rigid rear axle and independent front suspension, together with a low roll center, four coil springs, and hydraulic telescopic shock absorbers, gives the SAAB excellent roadholding, anti-sway and anti-dip properties.

Steering, which is rack and pinion with 2¼ turns from lock to lock, responds precisely to the touch of the driver.

Interior appointments are simple but neat, and more than neat—functional. The two front seats are outfitted with foam rubber cushions, and the rear seats are shaped to give good support sideways and can be hinged forward. Together with a special bed outfit, the seats and cushions can be arranged to form a comfortable overnight resting place for two people. The luggage compartment is spacious and more than sufficient for this small family car.

The body is aerodynamic in design with a complete belly pan. Finish is synthetic enamel, applied and baked with care.

Although its design does not mark it as a thing of beauty, it is attractive. But its main appeal lies in the pleasure derived from its excellent handling characteristics and lively performance.

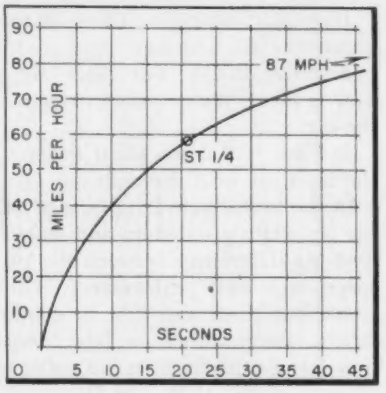
SIMCA

ONE of the most memorable cars we have ever driven is the Simca Aronde 1300. To drive it is to be sold, lock, stock and barrel. Its exterior is clean and handsome, its styling thoroughly acceptable by Detroit-conditioned standards. Its interior is beautiful. The fabrics and colors are a pleasure to look upon and close inspection reveals many surprises: two big glove compartments with well-patterned polished aluminum *doors*, padding below the dash to protect the front-seat passengers' knees, typically-French ingenuity in the layout of minor controls carried to its highest level, a streamlined pod around the steering column into which is blended one of the smoothest column gearshifts you'll ever use. And so it goes: evidences of careful thought and bonus quality throughout the car.

And then you drive it. The engine idles silently. You have to strain your hearing to be sure it's running. It is vibration-free throughout its whole speed range. The performance of this light car is literally amazing. It flies like the wind in all gears and you find it almost impossible to believe that there are fewer than 1300 cc's at work under the hood. The Simca is simply a bomb. Its terrific vitality and torque are hard to find even in cars costing half again as much.

The Simca's roadholding, handling and braking are up to the same lofty standards. Its suspension is terrifically rugged. The car has been officially clocked at Montlhéry at an average of 64 mph for 100,000 kilometers, or 61,000 miles. The high-compression export model has a much higher top speed. We talked with one owner who was clocked at over 84 mph over a 14-mile police radar trap in the desert. He swears that his worst gas mileage has been 31.5 mpg.

Simca wants to sell cars for U.S. dollars and the sympathetic French government has granted the company an export subsidy by relinquishing its tax on manufactured items. Thus it is possible to buy the Four-door Elysée model for $1697 at U.S. port of entry while the same machine costs $1717 in Paris. A wide variety of body styles is available on the 1300 chassis, including a convertible, a station wagon, a pickup truck and several utility vehicles. The Simca will give its competitors fits.



SUNBEAM RAPIER

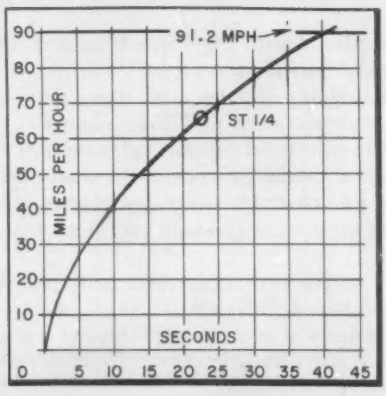
THE 2¼-liter Sunbeam, so famous for its success in Alpine competition, is no longer being seriously imported into the U.S. The Rootes Group is replacing it with a car certain to have broader appeal and, in spite of its smaller engine, more exciting performance. The new car is the Sunbeam Rapier and a Rootes spokesman assures us that it is designed specifically for the U.S. market.

The buyer Rootes intends to pin down with the Rapier is the sports-car conscious individual who needs a weather-tight car that can carry four persons in comfort. At this writing the first shipment of Rapiers is on the high seas bound for U.S. ports, and all our information concerning the car has of necessity come from the manufacturer's literature and from his American agents.

Style-wise the Rapier is a tasteful design in the American idiom. The only aspect of its appearance likely to seem at all alien is its size. It is intended to accommodate four and no more. The interior promises to be nicely finished in pleated plastic fabrics in bright color combinations. The instrument panel includes in its large assortment of dials a big rev counter and speedometer. The counter is red-lined at 5500 rpm, but we're assured that the 85 cu. in. engine can be wound to 6000.

This power unit is a specially tuned version of the ohv four used in the Hillman Minx. Its gross bhp of 62.5 and torque of 73.2 lb.-ft. are made possible by a higher compression ratio, enlargement of the entire intake and exhaust system and the use of light tubular pushrods with increased valve spring pressures. This recently designed engine, with its equal bore and stroke, rugged crankshaft and con rods, and large lower-end bearings, is a natural for increased urge.

While all the parts of the Rapier that meet the casual eye look not at all racy, all the emphasis beneath the sheet metal has been concentrated on sports-type character. Finned brake drums, ball-joint front suspension and heavy-duty rear springs are among the components that should contribute to outstanding road behavior. Pushbutton-controlled overdrive is standard. It acts on the two top gear ratios, giving the flexible effect of a six-speed transmission. Top speed will be about 90 mph.



VOLKSWAGEN

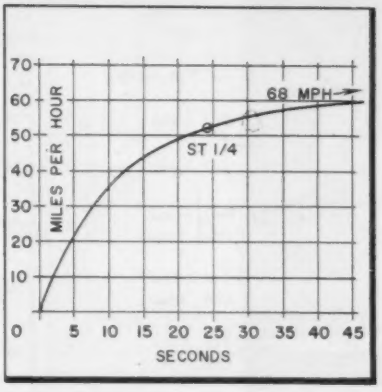
THE VW, discoverer of the gold mine that every other overseas manufacturer is scrambling for a share of, is still lord of the U. S. light car market. But from here on it's going to have to fight to hold its own.

The VW has its limitations. Its rivals have made a careful study of them and recite them from memory. The most valid criticisms of the People's Car are (1) it's underpowered, lacks hill-climbing and passing ability; (2) it could use more passenger and luggage space.

As described on page 46, speed tuners have at last found a successful and inexpensive method of outwitting the engine's built-in breathing restrictions. VW owners who want their cars to go like Porsches have the answer to their wish. As for payload space, the VW is better than some. The important thing is that the VW is a four-place car designed to meet specific standards of size, cost, service and economy. No car is perfect, and no serious critic can claim that the VW is not a very successful solution to the problem of providing comfortable, cheap, reliable transportation for the largest number of motorists everywhere.

There are other considerations that will make it difficult for anyone to nudge the VW off its pinnacle in the U.S. One is the marque's gigantic dealer and service network, backed up by equally large stocks of replacement parts. Another is the psychological phenomenon known as acceptance. Tens of thousands of Americans have taken the VW to their bosoms and they spread the VW gospel wherever they go. Then there is the precision, quality finish that the factory manages to give its cars. Whether or not you admire their looks you can't help being impressed by the quality of paint, chrome and assembly – the way everything works just as it was intended to.

When competition gets tough, which it hasn't yet, who can best afford to play the price-cutting game – a newcomer or big, rich VW? The VW success story came true solely because of the virtues of the product, and these will retain their value for a long time to come.



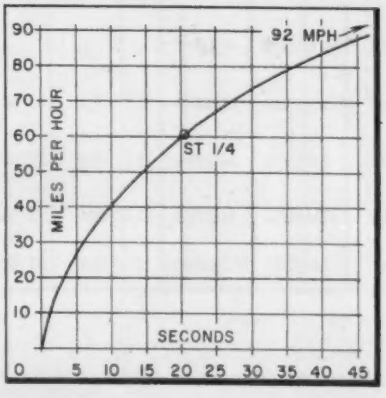
VOLVO

A FEW months ago a Southern California importer brought in his first shipment of Swedish light cars, the Volvo PV444's. Patriotic Swedes snapped up the lot, but he held on to one car. He knew that the best way to call the attention of large numbers of enthusiasts to an unknown machine is to race it. After one short highway trip in the Volvo he was convinced he had a winner. So far he has entered races twice at Palm Springs and once each at Torrey Pines and Santa Barbara. Four starts, four wins.

A somewhat plain but very solid-looking machine, the Volvo is one of those cars you never forget having driven. You can't because you just can't accept the fact of the car's blazing performance. The twin-carb, 70 bhp sports engine revs with the willingness of a racing mill, but has the smoothness that can only be achieved through careful balancing and matching of internal parts. We are told that the engine's combustion chambers and ports are polished, that its main-bearing inserts are replaceable without removal of the crankshaft, and that a great many parts, including the entire electrical system, are standard replacement items available throughout the U. S.

We drove the well-flogged veteran of four race wins. The car had been in constant daily use as a demonstrator and town hack. In other words, it was not in tip-top tune. It peels rubber in First gear very cheerfully, and leaps to an indicated 30 mph in six seconds flat, a little time being lost in popping a shift to Second. Once in Second you can stay there all day if you choose. The acceleration and engine braking in this ratio are just plain astounding – an adjective that applies pretty accurately to everything about the Volvo's performance. Using First and Second only you can bound from zero to an indicated 40 in 8.7 seconds, to 50 in 12.1 and to 60 in 21.5. Factory literature says that a properly tuned PV444 will do the latter in 19.6.

The Volvo handles precisely like a U. S. car, only better. Sturdy radius rods on the rear axle account for the car's right-now takeoff. It corners on rails. Front passengers ride in bucket seats; there's good room for three in the rear, and the luggage space is huge. Needless to say, the Volvos are selling on sight.



Make and Model	Body Types and Pass. Capacity available	Cylinders & Arrangements	Valve Arrangement	Bore and Stroke		Piston Displacement		Compression Ratio (to 1)	Maximum BHP @ RPM	Maximum Torque Lbs./Ft. @ RPM	Transmission Gear Ratio				Rear Axle Ratios
				Inches	Millimeters	Cub. Inches	Cubic Centimeters				4	3	2	1	
ALFA ROMEO GIULIETTA	4-dr, 4-pass.	4 I.L.	dohc	2.91 x 2.95	74 x 75	78.69	1290	8.0	50@5200	NA	4.55	6.19	9.55	16.35	4.55
AUSTN A50 CAMBRIDGE	4-dr, 4/6-pass.	4 I.L.	ohv	2.88 x 3.50	73 x 89	91.46	1500	7.2	50@4400	70@2100	4.875	7.26	11.71	19.23	4.875
BORGWARD ISABELLA 60	4-dr, 4/6-pass. Cpe, 2-pass., Conv. 2-pass.	4 I.L.	ohv	2.97 x 3.325	75 x 84.5	91.10	1493	6.8	60@4500	82.3@2500	3.9	5.3	8.39	14.05	3.90
BORGWARD ISABELLA TS	4-dr, 4/6-pass.; Cpe, 2-pass.; Conv., 2-pass.	4 I.L.	ohv	2.97 x 3.325	75 x 84.5	91.10	1493	8.2	75@4500	NA	3.9	5.3	8.39	14.05	3.90
CITROEN 2 CV	4-dr, 4-pass.	2 H.O.	ohv	2.60 x 2.44	66 x 62	25.90	425	6.2	12@3500	16.6@1800	5.68	7.46	12.56	25.9	3.88
DKW Three-Six	2-dr, 4-pass. Cpe, 4-pass. Conv, 4-pass. Stn. Wgn. 4-pass.	3 I.L.	–	2.79 x 2.99	71 x 76	54.63	896	7.1	42@4250	50.6@2000	4.3	6.2	10.5	18.0	4.72
FORD ANGLIA	2-dr, 4-pass.	4 I.L.	S.	2.50 x 3.64	63.5 x 92.5	71.55	1172	7.0	36@4500	52@2500		4.43	8.89	16.232	4.43
FORD PREFECT	4-dr, 4-pass.	4 I.L.	S.	2.50 x 3.64	63.5 x 92.5	71.55	1172	7.0	36@4500	52@2500		4.43	8.89	16.232	4.43
FORD CONSUL	4-dr, 4-pass. Conv, 4-pass.	4 I.L.	ohv	3.125 x 3.00	79.4 x 76.2	92.00	1508	6.8	47@4400	72@2000		4.55	7.48	12.939	4.56
FORD ZEPHYR	4-dr, 4-pass. Conv, 4-pass.	6 I.L.	ohv	3.125 x 3.00	79.4 x 76.2	138.0	2262	6.8	68@4200	108@2000		4.4	7.3	12.6	4.44
FORD ZEPHYR ZODIAC	4-dr, 4-pass. Conv, 4-pass.	6 I.L.	ohv	3.125 x 3.00	79.4 x 76.2	138.0	2262	7.5	71@4200	112@2000		4.4	7.3	12.6	4.44
HILLMAN MINX	4-dr, 4-pass. Hardtop, 4-pass. Conv, 4-pass. Stn. Wgn, 4-pass.	4 I.L.	ohv	3.00 x 3.00	76.2 x 76.2	84.82	1390	7.0	47@4400	66.3@2800	4.78	7.13	11.81	17.05	4.78
HILLMAN HUSKY	2-dr, 4-pass.	4 I.L.	S.	2.56 x 3.74	65 x 95	77.13	1265	6.63	37.5@4100	55.5@2200	4.8	7.1	11.8	17.0	4.78
METROPOLITAN	Cpe, 2/3-pass.	4 I.L.	ohv	2.57 x 3.49	65.5 x 88.9	73.17	1200	7.2	42@4500	62@2400		4.63	7.1	11.27	4.63
MG MAGNETTE	4 dr, 4-pass.	4 I.L.	ohv	2.876 x 3.50	73.03 x 88.9	90.88	1489	7.15	60@4600	76.1@3000	4.88	6.70	10.79	17.75	4.88
MORRIS MINOR	4-dr, 4-pass.; 2-dr, 4-pass.; Conv, 4-pass.; 2-dr, Stn. Wgn.	4 I.L.	ohv	2.28 x 2.99	58 x 76	50.00	803.5	7.2	30@4800	40@2400	5.4	9.0	13.9	22.0	5.38
PANHARD DYNA	4-dr, 6-pass.	2 H.O.	ohv	3.35 x 2.97	85 x 75	52.00	850	7.25	42@5000	47@3500	4.7	6.15	9.2	16.3	6.15
RENAULT 4CV (750)	4-dr, 4-pass.	4 I.L.	ohv	2.15 x 3.16	54.5 x 80	45.63	747	7.25	21@4200	33.25@2000		5.05	8.54	17.4	4.71
RENAULT DAUPHINE	4-dr, 4-pass.	4 I.L.	ohv	2.28 x 3.15	58 x 80	51.41	845	7.25	30@4250	48.4@2000		4.67	7.91	16.2	4.37
SAAB	4-dr, 4-pass.	3 I.L.	–	2.6 x 2.87	66 x 72.9	45.6	748	7.3	37.5@5000	52.1@2000		5.10	8.31	16.74	5.10
SIMCA ARONDE 1300	Deluxe 4-dr, 4-pass. Elysee 4-dr, 4-pass. Grand Large 2-dr, 4-pass.	4 I.L.	ohv	2.91 x 2.95	74 x 75	78.70	1290	7.2	48@4500	66@2600	4.4	6.5	10.5	16.5	4.44
SIMCA COUPE DE VILLE	Cpe, 2-pass. Conv, 2-pass.	4 I.L.	ohv	2.91 x 2.95	74 x 75	78.70	1290	8.0	63@5000	NA					4.44
SUNBEAM RAPIER	4-dr, 4-pass.	4 I.L.	ohv	3.00 x 3.00	76.2 x 76.2	84.75	1390	8.0	62@5000	73.2@3000	5.2	7.8	12.9	16.6	5.22
VOLKSWAGEN DELUXE	2-dr, 4-pass. 2-dr. Conv, 4-pass.	4 H.O.	ohv	3.04 x 2.52	77 x 64	72.68	1192	6.6	36@3700	56@2000	3.61	5.41	8.27	15.84	4.4
VOLKSWAGEN, KARMANN	Cpe, 2-pass.	4 H.O.	ohv	3.04 x 2.52	77 x 64	72.68	1192	6.6	36@3700	56@2000	3.61	5.41	8.27	15.84	4.4
VOLVO PV444	2-dr, 4-pass.	4 I.L.	ohv	2.95 x 3.15	75 x 80	86.62	1419	7.8	70@5500	75.9@3000		4.55	7.37	14.7	4.55

No. & Make of Carburetors	Wheelbase	Widest Tread	Length	Width	Height	Ground Clearance	Turning Circle (Ft.)	Turns Lock-to-Lock	Weight Dry	Tire Size	Volts	Fuel Tank Capacity (U.S. Gals.)	Suspension		Brakes	Cheapest Model Price at Port of Entry (L.A.)
													Front	Rear		
1-SO	93.7	50.0	157.0	60.5	55.3	6.3	36.0	3	1940	155 x 15	12	NA	I. C.	C.	H.	$2799
1-ZE	99.3	48.5	162.0	61.5	61.5	7.0	36.0	2.75	2240	5.60 x 15	12	10.5	I. C.	S. E.	G. H.	1898
1-SO	102.5	53.2	172.0	67.0	57.0	6.9	36.0	3	2161	5.90 x 13	6	10.5	I. C.	I. C.	H.	2395
NA	102.5	53.2	173.0	67.2	57.7	6.9	43.0	NA	2161	NA	6	10.5	I. C.	I. C.	H.	–
1-SO	93.5	49.5	149.0	58.2	63.0	7.5	35.5	2¼	1120	125 x 400mm	6	5.3	I. C.	I. C.	O. L. H.	1190
1-SO	92.0	59.0	166.0	66.0	57.5	7.7	36.0	2¼	1917	5.60 x 15	6	12.0	I. Tr.	I. Tr.	O. H.	1995
1-SO	87.0	48.0	151.0	60.5	58.7	7.0	32.7	2	1623	5.20 x 13	12	8.4	I. C.	S. E.	G. H.	1445
1-SO	87.0	48.0	151.0	60.5	58.7	7.0	32.7	2	1721	5.20 x 13	12	8.4	I. C.	S. E.	G. H.	1545
1-ZE	100.0	50.0	164.0	64.0	60.7	6.6	40.5	2⅔	2255	5.90 x 13	12	10.8	I. C.	S. E.	G. H.	1695
1-ZE	104.0	50.0	172.0	64.0	60.7	7.1	41.5	2⅔	2460	6.40 x 13	12	10.8	I. C.	S. E.	G. H.	1895
1-ZE	104.0	50.0	172.0	64.0	60.7	7.1	41.5	2⅔	2522	6.40 x 13	12	10.8	I. C.	S. E.	G. H.	2195
1-ZE	93.0	48.6	159.5	63.5	60.0	7.0	33.0	2½	2128	5.60 x 15	12	8.7	I. C.	S. E.	L. H.	1699
1-ZE	84.0	48.6	145.5	62.0	61.0	6.5	31.0	2½	1862	5.00 x 15	12	7.5	I. C.	S. E.	L. H.	1465
1-ZE	85.0	45.3	149.5	61.5	54.5	6.4	36.0	2½	1875	5.20 x 13	12	10.5	I. C.	S. E.	G. H.	1725
2-SU	102.0	51.0	169.0	63.0	58.0	6.5	37.5	2¾	2404	5.50 x 15	12	11.1	I. C.	S. E.	L. H.	2495
1-SU	86.0	50.6	148.0	61.0	60.0	6.8	33.0	2½	1632	5.00 x 14	12	6.0	I. Tor.	S. E.	L. H.	1495
1-SO	101.0	50.0	180.0	62.0	55.0	7.0	32.0	2	1546	145 x 400mm	12	10.7	I. Tr.	Tor.	L. H.	2245
1-SO	82.0	48.0	143.3	56.0	58.0	7.1	27.5	3½	1232	5.20 x 15	6	7.8	I. C.	I. C.	L. H.	1395
1-SO	89.0	49.0	155.0	60.0	57.0	6.0	28.0	3½	1000	5.00 x 15	6	NA	I. C.	I. C.	H.	1595
1-SO	98	48	157	61.5	57	7.5	36.0	2¼	1734	5.00 x 15	12	7.0	I. C.	C.	H. O.	1795
1-SO	96.0	49.3	162.0	61.2	62.7	5.5	31.0	3	1940	5.60 x 14	12	10.0	I. C.	S. E.	L. B. H.	1588
1-SO	96.1	49.3	167.7	61.8	NA	5.5	31.1	NA	1988	5.60 x 14	12	10.0	I. C.	S. E.	L. B. H.	2495
1-ST	96.0	49.0	160.5	60.7	58.0	7.0	34.2	2½	2280	5.60 x 15	12	12.0	I. C.	S. E.	L. H.	2499
1-SO	94.5	51.0	157.0	60.5	59.0	6.8	36.0	2¼	1620	5.60 x 15	6	10.5	I. Tor.	I. Tor.	L. H.	1595
1-SO	94.5	50.8	163.0	64.2	52.2	6.8	36.0	2¼	1782	5.60 x 15	6	10.6	I. Tor.	I. Tor.	L. H.	2495
2-SU	102.5	52.0	177.0	62.0	61.5	NA	32.4	3¼	2260	5.90 x 15	6	9.5	I. C.	C.	H.	1995

NOTES: Cylinder arrangement: I.—In line, H.O.—Horizontally opposed.
Valve arrangement: dohc—double overhead camshaft; ohv—overhead; S.—side.
Carburetors: SO—solex; ZE—Zenith; SU—S.U.; ST—Stromberg.
Suspension: I.—Independent; C.—Coil; S.E.—Semi-elliptic; Tr.—Transverse; Tor.—Torsion bar.
Brakes: H.—Hydraulic; G. Girling; O.—Own; L.—Lockheed; B.—Bendix.
O.D.—Overdrive.
NA—Information not available.

Plucky

BRITISH motorists fall into two main categories: Austin Seven enthusiasts, and people who can afford an automobile.

Since types with dough are always outnumbered by the rest of us, the dinky little family runabout which manufacturer Sir Herbert Austin designed with cue chalk on the green felt of a pool table, one night in 1922, is the smallest but also the best loved car that ever hit the British market.

With a wheelbase of 81 inches, and a simple but rugged four-cylinder, 747.5 cc side-valve engine, developing 17 brake horsepower at 4500 rpm, the Austin Seven "Chummy," an aluminum-bodied tourer, put England on wheels. In various modified versions it practically wrote its own ticket in light-car racing of the twenties. Never before had there been so plucky and versatile a little scrapper. Austin's Australian representative wrote the factory suggesting they supercharge a Seven so he could win the Australian Grand Prix with it. They did and he did. Another Austin driver took the 1924 200-Mile Race at an average speed of 75.61 mph, a drop of 1.23 mph over his previous year's winning average. Puzzling — until he discovered he had shed a pis-

The Baby Austin ranks beside Ford's Model T as one of the great designs of history. Owners will concede only that it is the greatest design ever executed on a pool table.

Anything this quaint would stop traffic in the U. S. In England the Austin Seven "Chummy" which changed but little from '22 to '35 rates no stares. Solid, despite flimsy appearance, the Chummy weighs in at 900 lbs.

Seven

By MERWIN DEMBLING

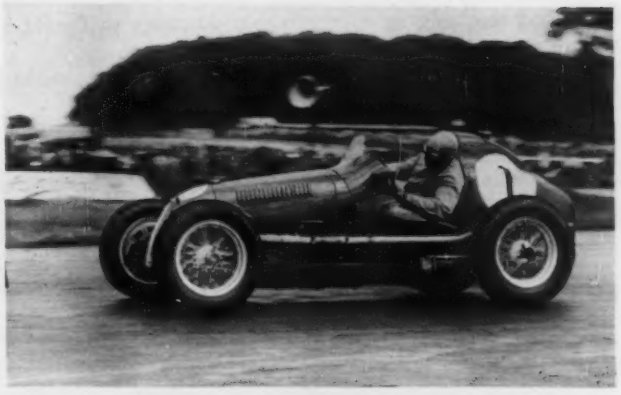
ton and con rod at some point during the festivities. His car had gamely fought its way home first — on three cylinders.

Speeds kept getting higher and higher. By 1934 an Austin Seven — so much modified that the original "Chummy" sort of receded into the far distance — took the Flying Start Kilometer record at 122.74 mph, but after a hood-to-hood struggle the more intricate and much costlier MG set just too fast a pace.

By the time that happened, though, the Baby Austin had kicked the persnickety two-stroke cyclecar into limbo, bounced the financially shaky Austin Motor Company well over to the black side of the ledger, and planted Sir Herbert himself in the House of Lords.

This would all be ancient history, except that the Austin Seven is still very much in evidence all over England, and the same goes for Scotland, Ireland and Wales. Close to half a million rolled off the Birmingham assembly lines in a production run that lasted from 1922 to 1938. The essentials of the design remained unchanged.

All the blueprints originated in Sir Herbert's billiard



They may not have been big, but the OHC Austin race cars developed one bhp for every 2¼ lbs., enough to trample much larger equipment. Main relationship to the Seven was the name and the 744 cc displacement.

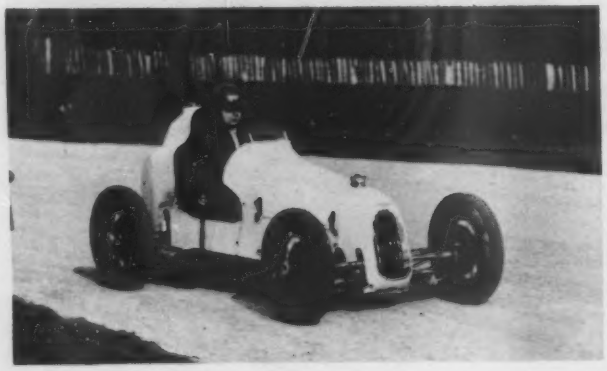
room during the entire run but small factory modifications brought big name changes. The Chummy, the Brooklands, the Sport Seven, the Ulster, the Nippy, the Speedy, the "65," the "75," the Ruby, and the Big Seven are all virtually the same Baby Austin.

Fiddled with by private firms of hop-up experts and coachbuilders, the Gordon England Cup, the B.C., the K.C., the A.E.W., the Taylor, the Lotus (not the Chapman version), the Swallow, the Arrow, the Stadium, the Burghley, and dozens of others now forgotten, are also virtually the same car. Take away the flashy bodies, the superchargers, the balanced crankshafts, the enlarged valve ports and fancy suspensions — and you're back with the classic Baby Austin.

Thousands are still providing transportation for Mom, Dad and the kids, at a remarkable 40 miles to the U. S. gallon and an unremarkable 35-40 mph.

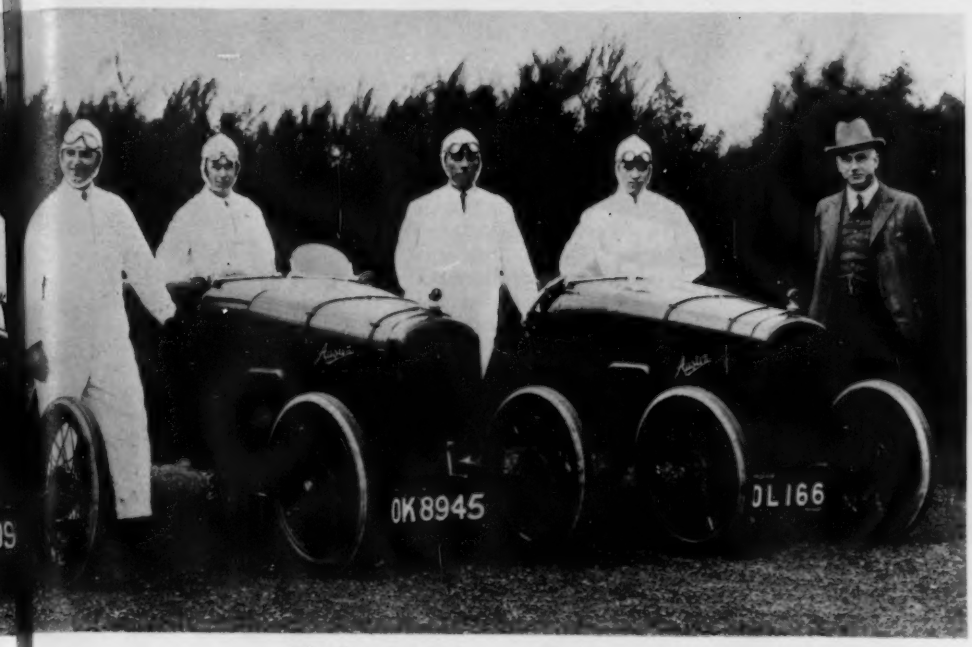
Thousands of others have been stripped down, worked over, and juiced up by private enthusiasts. Blessed with an unusual A-shaped chassis frame, rigid enough to stand the stresses of competition driving with even the scantiest of backyard bodies, and an engine with lots of room — and metal — for improvement, the Austin Seven forms the basis for more sports specials than any other car in Europe. Though the car itself has been extinct for the past 18 years, there are so many warming-up outfits still being made — including high-compression heads, overhead valve conversions, twin-carb kits, four-branch exhaust layouts, lowered front axles, flattened rear springs, and split-axle IFS — that the Seven is sometimes referred to as "the grown-up's Meccano" — British counterpart of the Erector set. The Seven-Fifty Motor Club, devoted principally to competition featuring Austin-Seven-based sports cars, has close to 2000 members, making it one of the largest motor sports organizations in Europe.

It is an exaggeration to say that driving a Baby Austin



This is the last Austin Seven racing model built in 1939. Development of this model was cut short by the war, but in its short-lived career piled up an impressive list of wins.

During the years before World War II, Austin Sevens formed the basis for more specials than any other car in Europe. All were successful.



Photos courtesy the LIGHT CAR, England

The first Austin Seven racing team, 1923. These cars were essentially stock Chummies — except for higher gear ratios, twin carbs, high-lift camshafts and fabric bodies instead of aluminum. Two of the cars retired with burnt-out bearings, and the remaining car crashed.

these days is always a symptom of anemia of the bank account. "Sevenosis," like measles, is a childhood disease almost everybody goes through. If caught in time, it can be cured by small but regular doses of income, but the recovery rate is not quite 100 percent. Some people never get over the Seven's peculiar charm. They remain hypnotized by the fact that, though this least possible motorcar is undergeared and underpowered, it can still be relied upon to transport four people from A to B in relative comfort and at a moderate speed.

With a few reservations. Provided the road between A and B is fairly level. Provided the weight of the four people doesn't go much above 750 lbs. And provided the two who are sentenced to the back seat have retractable knees or don't measure over four feet from head to heels in the first place.

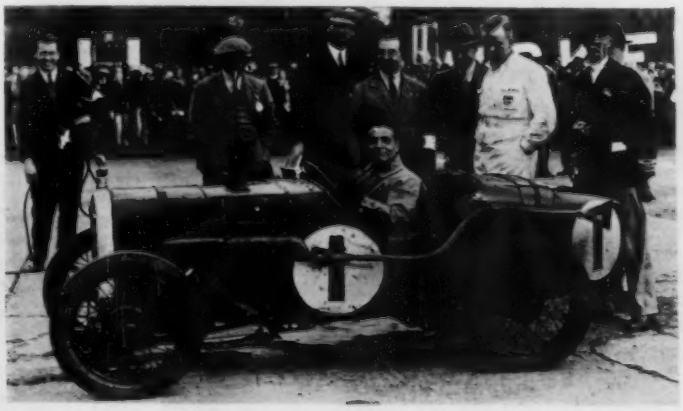
Overloading produces alarming sags in the suspension system Sir Herbert skillfully lifted from Bugatti's designs for the Bebe Peugeot. An upgrade makes the speed of the Seven so moderate as to verge on the depressing. And a downgrade is apt to make the trip from A to B hair-raising. Genuine Austin Seven brakes are such that it's even money the car shoots right by B, and after some frantic struggling on the part of the driver, only squeaks to a stop somewhere around W.

These are major shortcomings; how come the Austin Seven was — and is — so popular?

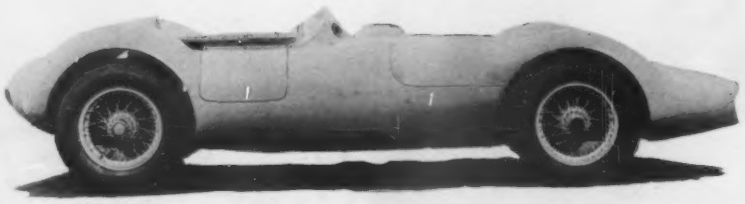
Price is, naturally, one factor. Fifty bucks gets you a good one, which makes the Seven the cheapest thing on four wheels in Britain's steep-used-car market. After that comes reliability. While the Austin Seven in stock form never did much, it does it all the time. The brakes are not so hot, but they stop the car eventually. A top speed of 40 isn't thrilling, but it's better than a spurt of 80, followed by weeks of walking while various disgruntled moving parts are regruntled.

(Continued on page 61)

Few changes were made in Sir Herbert's original billiard table design. Sedans such as this one are still family transportation in England.



Small but potent scrappers like this accounted for Austin's racing successes in Australia and on the Continent.



Lister's Latest

By ALBERT DOUGLAS

"Its small frontal area and power-output of over 170 bhp is a speed recipe."

THERE is no doubt that currently more small-quantity sports and competition cars are built in the British Isles than in any other country in the world, with the possible exception of the United States. Their birthplaces vary from backyard sheds to quite impressive small factories, but the Lister works in the age-old University city of Cambridge must be the most unusual of them all.

The 2-litre Maserati engine fits snugly into the Lister frame. Radiator is angled to conform with the sloping hood lines. Note light front suspension.

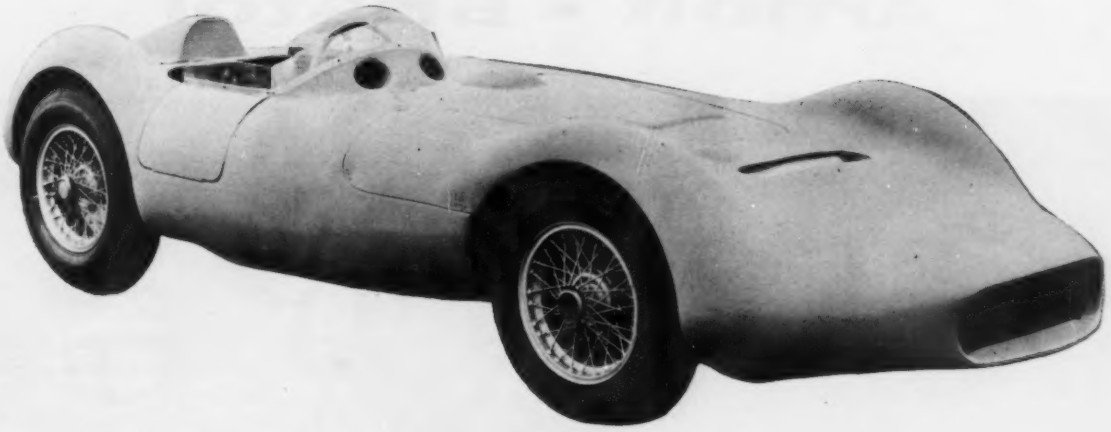
Driving force behind the Lister sports racing car is burly Brian Lister, whose Grandfather founded the family engineering business over sixty-five years ago. It started on the very spot where now stands the machine shop. Then it was Grandpa Lister's family engineering business with Brian's father in control, making agricultural machinery, hoppers, steel and bronze fittings for churches, ornamental gates and so on. Lister cars are built side by side with these unusual companions, and what is more, they are built with the same painstaking attention to detail, finish and to high engineering standards.

Brian Lister has not unnaturally been an engineer for most of his life, and a motor racing enthusiast for a good part of it. In 1954 he decided that he should put some of the engineering business to use making a product that would carry the Lister name into a different field, and at the same time enable him to become involved in a sport which has fascinated him for many years.

His first car to the pattern which the current cars follow, appeared in competition for the first time in 1954. It was powered by a highly-tuned version of the ubiquitous MG TC engine and was highly successful. This was followed by a 2-liter Bristol-engined car which enjoyed phenomenal success, one of them the winning of the 2-liter class in the 1954 International Sports Car Race at Silverstone in front of many revered Continental marques reputed to have cost ten times as much money.

Lister was fortunate in not only having a well-designed car to go racing with, but also in having the driving services of his friend, brilliant Archie Scott-Brown. Archie is partly disabled, but anyone who has seen him drive (and win) will know that his reaction, speed skill are superior

RIGHT: Exhaust system is neatly tucked into body side. Two slots at rear expel air from brakes and final drive unit. BELOW: Front view of Lister-Maserati shows large ports below windscreen which are ducted to cool rear brakes and final drive.



to most. In addition to Archie as driver, Lister also has the services of Don Moore, a man who knows how to wrest hairy horses out of engines.

In 1955, the *Bristol*-engined works car only was raced, again with Archie at the wheel and again a formidable list of success was notched up including an outright win of the British Empire Trophy Race, and wins at Goodwood, Castle Combe, Brands Hatch, Shetterton and other British circuits. The MG-engined car was put into temporary retirement — as we shall see.

The impressive successes that the Lister was enjoying was prompting a considerable number of seasoned racing drivers to enquire whether replicas could be obtained. Lister was only too pleased to consider manufacture, he had had that in mind from the very commencement of his racing activities, but he had a problem.

(Continued on page 54)

Production Listers in 1955 had streamlined bodies with stabilizing fins. Most models were fitted with 2-liter Bristol engines.

Equal length wishbones make up the front suspension. Coil spring/damper units are not fitted here. Main tubular frame members have welded stiffeners. Rack-and-pinion gear is ahead of top crossmember.

SCI tests the Arnolt - Bristol

"...a car enthusiasts ought to be fighting to buy."

Gracefully designed by the Bertone coachbuilding firm of Turin, Italy, the aerodynamic body of the Arnolt-Bristol stands a mere 44 inches in height.

IT WAS 5 a.m. in the desert. The air temperature was a frigid 35 degrees, and the car hadn't been tuned since it left the factory many months before. I had already discovered that the stock plugs, fine for Britain's lower-grade fuel but not for premium U.S. gas, were misfiring, and that three of the brakes were dragging. The time and place were wrong for taking corrective measures, and I didn't expect much.

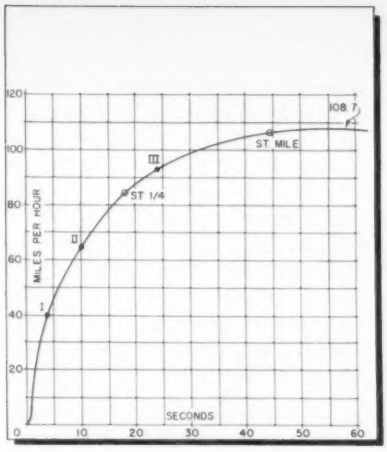
To start the car I went by the book. I pulled out the mixture-control lever and pressed the starter button. One spin of the crankshaft and the cold engine fired, ticking over at a fast warm up idle of 1500 rpm. The water temperature rose to a good operating level within three minutes, but the oil temperature was slow. After 10 minutes' warm up and five miles of tooling along below 2000 rpm, though, the oil stood at 40 degrees Centigrade. Now, according to the book, I could go ahead and use whatever the engine had to give.

First, the standing quarter-mile. I revved the engine to 5000 with clutch in and shift lever in first cog, popped the clutch and stood on the throttle. Low gear was quite high (low numerically) by touring car standards, and for a full second very little happened. The car started forward, moving like a rocket, slowly at first, gathering momentum. The tach needle crept around to 3000. Suddenly the racing cam effect came in. Within two seconds the needle was swinging past 5000, the speedometer read 40 and the valve gear was screaming its tension.

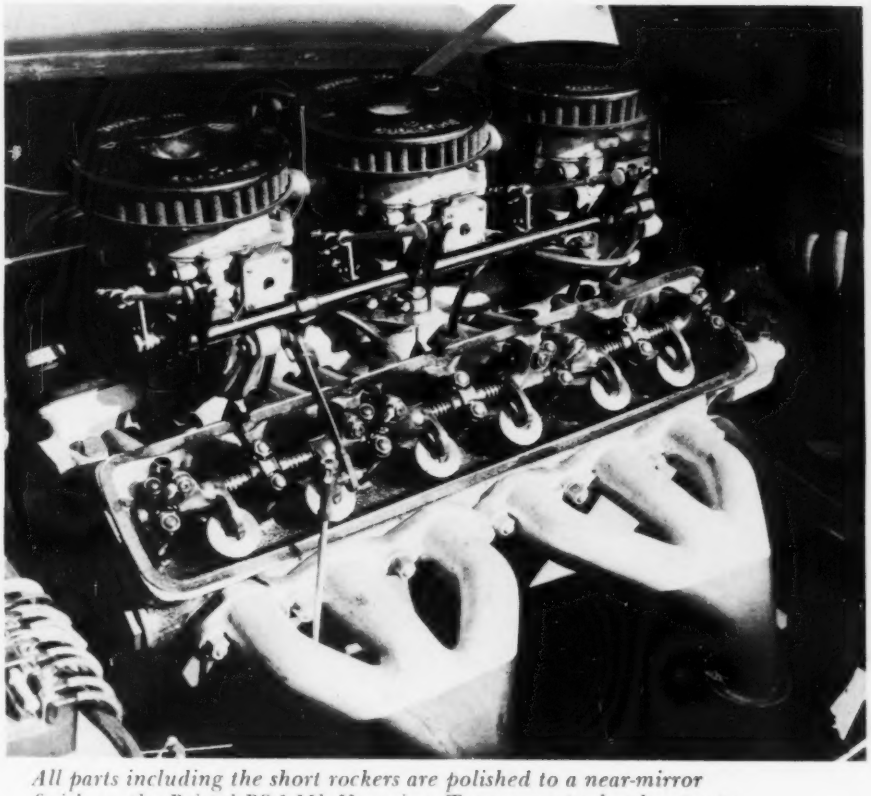
With foot hard on the throttle I punched the clutch, whipped the shift lever down to second and snapped the clutch out again, keeping the revs above the thrusty 3000 mark. I wound past 4000, listening to the *haawnk* of great volumes of air ripping through slender venturis become louder and stronger. Now the tach read 5000, and as it approached 6000 at 65 mph I popped another shift, still keeping the throttle pinned to the floorboards. There was the ascending engine note in second, the sudden descent, then as the clutch bit, the start of another, lower-keyed ascent. I wound on out in third at 6000, indicating about 95 mph, and threw the final shift into fourth. The engine, losing only a few revs, continued to drone its song of pure power. In 17 seconds flat I'd spanned the standing quarter, indicating nearly 90 mph in 1320 feet with a 120 cubic inch engine!

This, friends, is a *car:*

The Arnolt-Bristol is one of the finest real *high*-performance sports cars I've ever driven. Its engine and chassis have European lineage of unique distinction, and its beautiful body is one of Bertone's best. In competition form the car costs just $3995. Yet you can buy one without having to sweat out a long waiting list, and this is the fact that astonishes me. By all that's rational, hot-eyed enthusiasts ought to be snatching these machines off the boats as fast as S. H. Arnolt can produce them. The reason they aren't, apparently, is that there's a widespread notion that the A-B is some sort of cobbled-up U. S.



The razor-sharp edges of the Bertone coachwork are attained by careful finishing of the metal. Large airscoop helps accommodate tall engine and ducts cool air to three Solexes.



All parts including the short rockers are polished to a near-mirror finish on the Bristol BS-1 Mk II engine. Transverse pushrods actuate the exhaust rockers. In effect and in operation, this arrangement acts as a direct overhead camshaft.

Speedometer of the A-B indicated from 70-75 mph as the aerodynamic two-seater sped around test bend.

Weight distribution, and stable suspension geometry permit high cornering speeds with slight drift.

jalopy that happens to use the Bristol engine. This is far from true.

The Arnolt-Bristol is a purebred sports car. Its sweeping class win at Sebring in '55 proved that it's every bit the machine that Bristol-powered cars are across the Atlantic — cars that can win their class 1-2-3 at Le Mans and sustain over 125 mph for 200 miles at Montlhery. In the U.S., A-B's have finished ahead of two-litre Ferraris, 300-SL's and Jaguar XK140M's. There's nothing in the two-litre production class that can keep up with them.

The A-B is magnificent for short, straight road courses. It has a top speed of about 112 mph and it's geared to reach the maximum right away. The top speed it can achieve theoretically on a long desert highway is actually beside the point. What *is* the point is the fact that within a mile, from a standing start, it can come within a hairsbreadth of its potential maximum.

It thunders through first so fast that you need all your alertness to keep it from yielding its limit right there. Second and third ratios arm you to cope with any situation of acceleration, ascent or descent. Fourth is a dream. You can use it to pull smoothly from 20 mph or you can use it where it's happiest: cruising between 80 and 100 mph. Here the engine runs with a free and totally frictionless feel. This is a car that hungers to prance at 105 mph at only a nudge from the driver. Only at the bitter end of its top limit does it begin to tighten up.

The bodies Bertone has built for Arnolt are beautiful, and that's a deliberate understatement. The lines are essentially the same for all the body styles. Our test car was the simplest, the competition two-seater, which has a racing windscreen, and no top, side curtains or bumpers. Next in price is the Bolide model, which has full weather protec-

tion and a price of $4250. The De Luxe model, with top, side curtains, bumpers and an elegantly finished interior, sells for $4995. And finally there's the Coupe at $5995, which has roll-up windows and interior appointments that are really luxurious.

All these models derive their lines from Bertone's brilliant B.A.T. series of aero-dynamic body forms. No matter from what angle you view the Arnolt-Bristol, it has beauty, harmony, and integrity of line. At a three-quarter rear view, for example, the sharply sculptured curve of the front fender harmonizes faultlessly with the curves of windscreen and airscoop. The body is light, strong and practical. The doors are so light, so well-balanced and lightly-hinged, that I thought they must be made of aluminum. But they're of steel sheet, and so are all the panels except the hood and rear deck. This is good from the standpoint of strength, and strength has been an important consideration in the laying out of this body. Welded-in steel-sheet wheel wells give the body's front and rear extremities a boiler-plate solidness. Because of the structural strength you can haybale an A-B and pay for the damage without too much strain. For one reason or another two of these cars have been rolled in West Coast races. They came to rest on the high points of their fenders and the repair costs, including paint, ran between $150 and $175.

In the past I've seen some sad examples of "fine Old World craftsman-

TEST CAR:

Arnolt-Bristol 2-liter Competition model. Bristol 404 chassis, B.S. 1 Mk. II engine.

TEST CONDITIONS:

Number aboard	2, weight of passengers and instruments 340 lbs.
Top position	Down (no top on competition model)
Temperature	Top speed, 36°F. Acceleration, 74°F
Miscellaneous	No wind, top speed taken at sea level, acceleration at 950 ft.

PERFORMANCE

TOP SPEED:

Two-way average	107.3 mph
Fastest one-way run	108.7 mph

ACCELERATION:

From zero to:

30 mph	2.9 sec.	
40 mph	4.0	
50 mph	6.2	
60 mph	8.7	
70 mph	11.7	
80 mph	16.0	
90 mph	21.3	
100 mph	27.9	
Standing ¼ mile	17.0	(avg. 52.9 mph)
Speed at end of quarter	82 mph	
Standing mile	44.3 secs.	(avg. 81.4 mph)

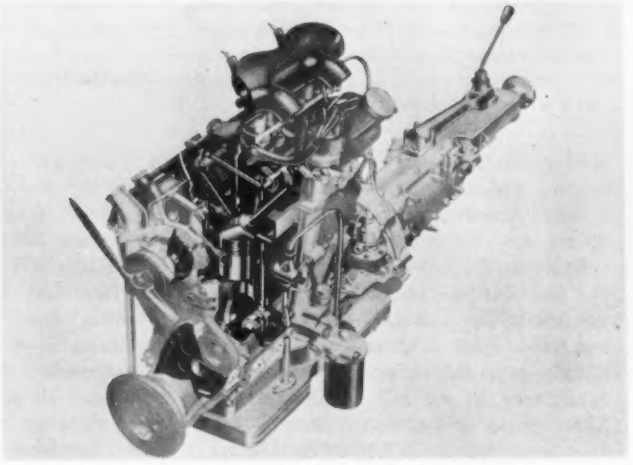
CHASSIS:

Wheelbase	96 ins.
Front Tread	51.25 ins.
Rear Tread	54 ins.
Suspension, front	Transverse leaf and A-arms
Suspension, rear	Rigid axle, longitudinal torsion bars
Shock absorbers	Hydraulic double-acting telescopic
Steering type	Rack and pinion
Steering wheel turns L to L	3
Turning diameter	32 ft. 10 ins.
Brake type	Lockheed hydraulic; two leading shoes at front
Brake lining area	148 sq. ins.
Wheel studs, circle diam.	Five 9/16 in. studs; 4¼ in. bolt circle
Tire size	5.50 x 16
Rim width (outside)	5⅞ ins.

GENERAL:

Length	167 ins.
Width	68 ins.
Height	44 ins.
Weight, test car	2120 lbs. with full fuel tank
Weight distribution, F/R	49/51
Weight distribution, F/R with driver and passenger	47/53
Fuel capacity— U. S. gallons	18.5

With excellent grouping of instruments, adjustable bucket seats, precise location of shift lever and handbrake, ample leg room for the lanky, the A-B cockpit leaves little to be desired.



Partial cutaway exposes valve train and operation. Single camshaft in block actuates intake valves by push-rods and rockers. Exhaust valves are activated by transverse rods impelled by bell cranks on intake rocker shaft.

ship" in which the sheet metal was just a rough base for a sculptor's skill with many pounds of body putty. This was the first thing I looked for in the Bertone body, but I could find nothing but paint and well-formed sheet metal. The razor edges of the fenders are areas that even the least cynical observer would be likely to suspect. But if you reach up under the body and feel inside you find that the razor edge was achieved by steel alone, and not by lead, putty or any other substitute for competence in metal-shaping.

The aerodynamics of this body are notable. If you're of average height – say from 5 ft. 6 ins. to 5 ft. 11 ins. – you ride in total comfort. The airstream gives you a gentle scalp massage and rips up and over the racing windscreen to deflect insects and other airborne impediments harmlessly. But extend your arm to make a turning signal and you discover how efficient the streamlined packaging is. You can almost break a wrist by testing the airstream too boldly at high speed.

The big airscoop in the hood is no dummy. Without it the car would have to be a good deal higher than it is, to accommodate its tall engine. The scoop channels cool outside air to the three Solexes that mix the engine's fuel and air.

The passenger space is one of the most acceptable I've found. Bertone's bucket seats are perfectly form-fitting and give superb lateral support to pas-

(Continued on page 55)

RATING FACTORS:

Bhp per cu. in.	1.08
Bhp per sq. in. piston area	4.07
Torque (lb-ft) per cu in.	1.05
Pounds per bhp-test car	16.3
Dry weight	1990 lbs.
Piston speed @ 60 mph	1850 ft. per min.
Piston speed @ max bhp	3465 ft. per min.
Brake lining area per ton (test car)	140 sq. ins.

SPEEDOMETER CORRECTION:

Indicated	Actual
30	29
40	38
50	47
60	56.5
70	66
80	75.6
90	82.5
100	92

FUEL CONSUMPTION:

Hard driving	16.5 mpg
Average driving (under 60 mph)	24 mpg

BRAKING EFFICIENCY:

1st stop	71 percent
2nd stop	71 percent
3rd stop	71 percent
4th stop	76 percent
5th to 10th stop	73 percent

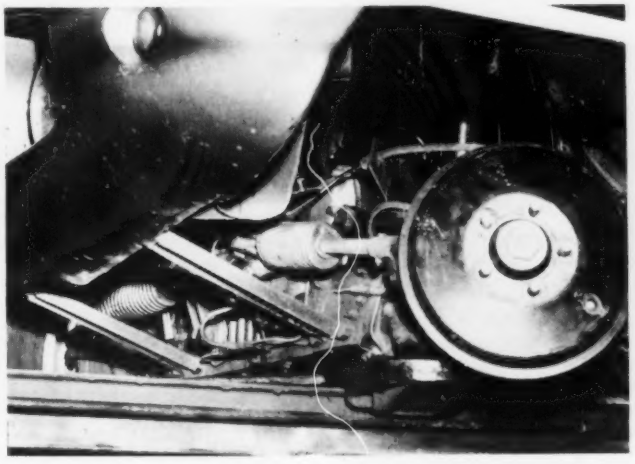
SPECIFICATIONS

POWER UNIT:

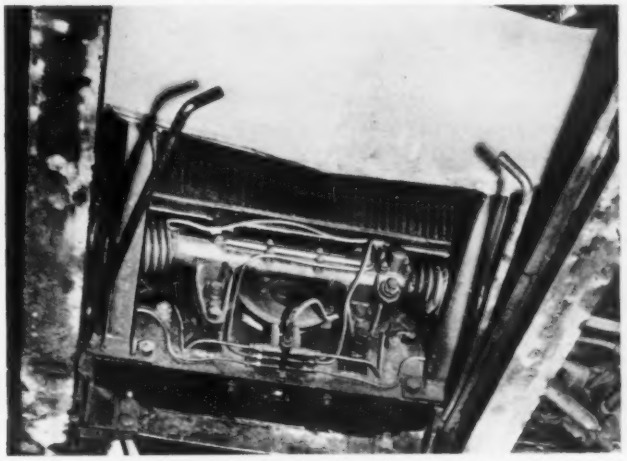
Type:	In-line six
Valve Arrangement	Vee-inclined ohv, pushrod operated
Bore & Stroke (Engl. & Met)	2.59 x 3.77 ins. 66 x 96 mm
Stroke/Bore Ratio	1.455 to one
Displacement (Engl. & Met.)	120.2 cu. ins., 1971cc
Compression Ratio	9.0 to one
Carburetion by	3 single-throat Solex type 32B1
Max. bhp @ rpm	130 @ 5500
Max. Torque @ rpm	128 @ 5000
Idle Speed	600 to 900 rpm
Ignition by	Lucas coil and single-breaker distributor

DRIVE TRAIN:

Transmission ratios	Overall	Gearbox
I	11.4	2.92
I	7.12	1.83
II	5.04	1.29
III	3.9	1.00



Front running gear detail. Eleven-inch brake drums lack finning and ventilating ports for cooling, but in spite of simplicity endure harshest treatment with impunity. Note concertina-type seals shield rack and pinion.



Front underchassis view of plumbing for Bristol chassis' excellent one-shot lubrication system. All running gear friction surfaces are sealed from dirt either by neoprene seals or by leather covers secured by straps and buckles.

SCI Technical Report:

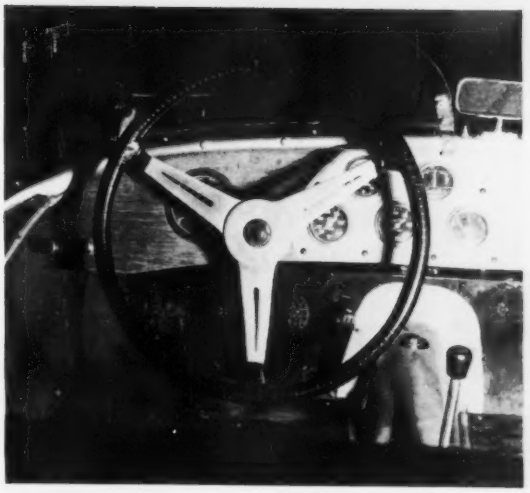
the PBX Crosley Special

"Candy" Poole at speed in his 750cc Crosley powered PBX Special. He took Modified class H honors in the Danvers Trophy Race at Beverly, Mass.

By KARL LUDVIGSEN

ONE day Candy Poole just plain got mad. Granted, the Hotshot chassis had all the stability of a wheelbarrow on the old Glen course, but it was kept in contention by sheer hard work under the hood. Poole knew that the little Crosley four-banger had a potential far beyond anything that was being realized in the shadowy days of 1952, but he also saw that he couldn't prove it until he was able to keep the car and the power on the road. When new-acquaintance Bob Bentzinger proved to be both a kindred soul and a qualified engineer, a partnership was formed, and as of Thanksgiving, 1952, PBX production was under way.

The story of a special differs from that of a factory car in that it is much more closely bound up with the man responsible for its creation. Since the original planning days, Candy Poole has borne the burden of the PBX development work, and when it comes to testing and race preparation he is a man of single-minded purpose. His friends and fellow class H competitors will testify that Candy is probably the most thorough and at the same time the fastest owner-builder-driver-tuner around. More than a few snags have arisen, but he has always been able to eliminate them at their source and without stopgap measures. That this vigilance pays off is indicated by the incredible record of 26 class wins and 32 finishes out of 35 starts. Lest the car be thought a mere reliable plugger, recall that for three years running it has beaten all comers in both classes G and H on the very tough Brynfan Tyddyn road course, and for the same period has been the top under 1500cc Modified machine in the New



Instrumentation of the PBX cockpit is very complete, employing Stewart-Warner gauges and a Sun tachometer. Finish of the wooden panelboard is exceptional for a special — superior even to a production dash.

Special's cockpit seats two people with comfort and ease. Passenger side of compartment looks smaller than driver's side because of hinged door, but seating space is equal.

Wide nose shields headlights and radiator of PBX Special which was first scale-modeled and then sent to the Aeroform company along with the chassis for the aluminum shell.

Canopy-like metal hinged to passenger compartment folds upward and closes as a door. Entrance and exit may be inconvenient and impractical, but it complies with FIA regulations.

England region of the SCCA. Both the PBX and its record are great, and it all depended on Candy Poole.

Much of the interest in a special story also lies in what the car has been, rather than what it is now. A review of the latter would be superficial in that it would miss the many solutions that were tried and failed, and would avoid the valuable lessons of what NOT to do.

Candy's main concern, then, was showing what the much ridiculed Crosley engine could do. He knew in the beginning that it was operating nowhere near its potential, but the realization of that potential turned out to be a tedious process. Much of the value of the Crosley engine for competition purposes stems from its integral head-block

(Continued on page 36)

SPECIFICATIONS PBX SPECIAL

ENGINE

Type	4 cyl., in line
Bore and stroke	2.54 in x 2.25 in (64 mm x 57 mm)
Capacity	45 cu in (748 cc)
Piston area	20.3 sq. in.
Compression ratio	10.5 to 1
Max. horsepower	55 @ 8000
Piston speed at max. horsepower	3000 ft/min

Valves	*Intake*	*Exhaust*
Head dia	1.17 in	1.05 in
Stem dia	.314 in	.313 in
Seat angle	45°	45°

Camshaft		
Open	20° BTC	60° BBC
Close	60° ABC	20° ATC
Lift	.350 in	.350 in

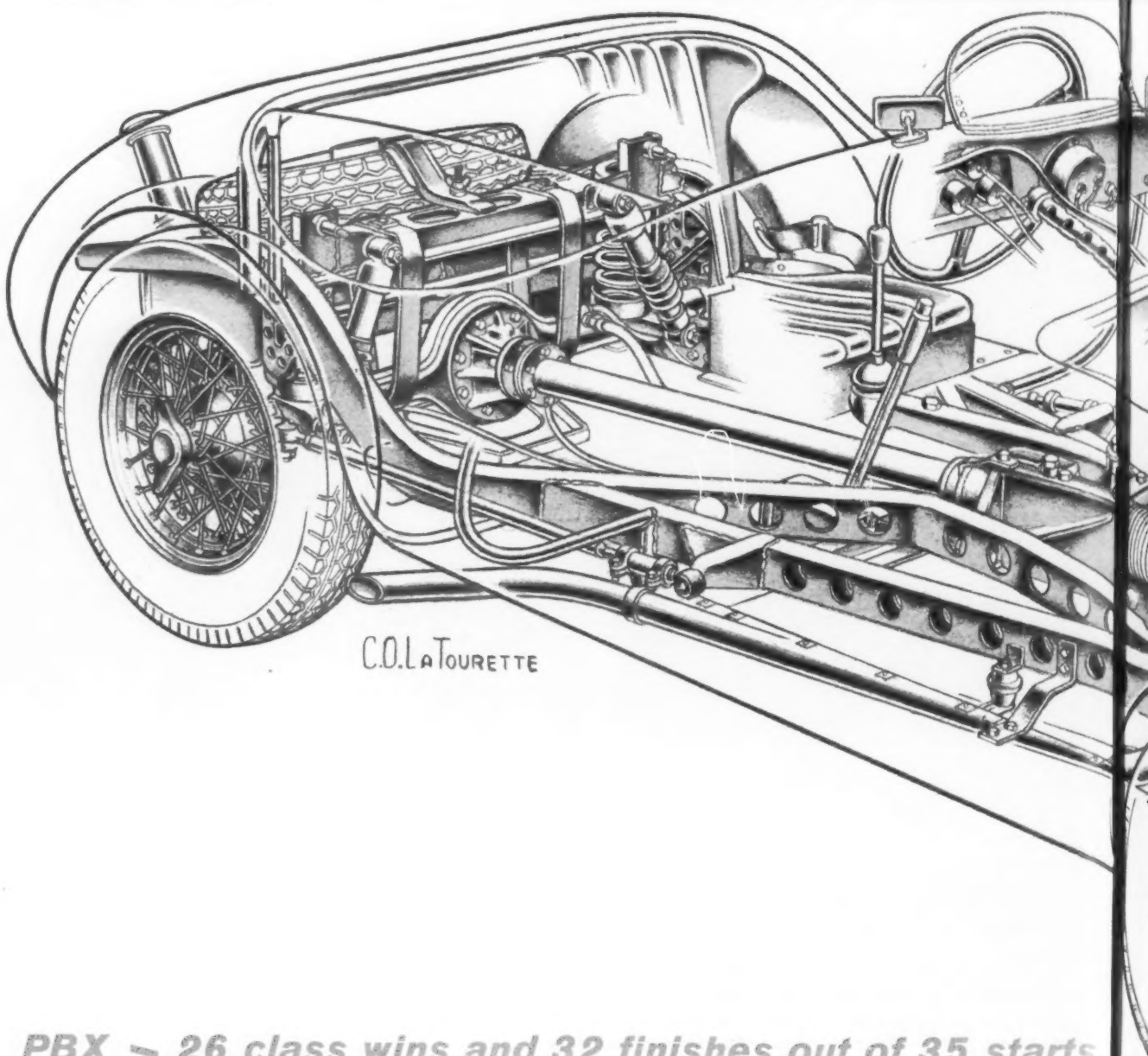
Carburetion 2 sidedraft Amals

Plugs	
Type	Champion J2
Gap	.018 in

Oil capacity 3.5 qts

Water capacity 1.25 gal

CLUTCH 7.25 in dia. Borg and Beck single dry plate



PBX — 26 class wins and 32 finishes out of 35 starts

GEARBOX

Ratios	4th	1:1
	3rd	1.36:1
	2nd	1.95:1
	1st	3.38:1
	Rev	3.38:1
Oil capacity	1.5 pints	

REAR AXLE

Ratios	4.875, 5.125, 5.17, 5.27, 6.00, 6.12
Oil capacity	1.75 pints

WHEELS 15x3½K Borrani light alloy wire

STEERING

Turns lock to lock	2½
Turning circle	30 ft

CHASSIS

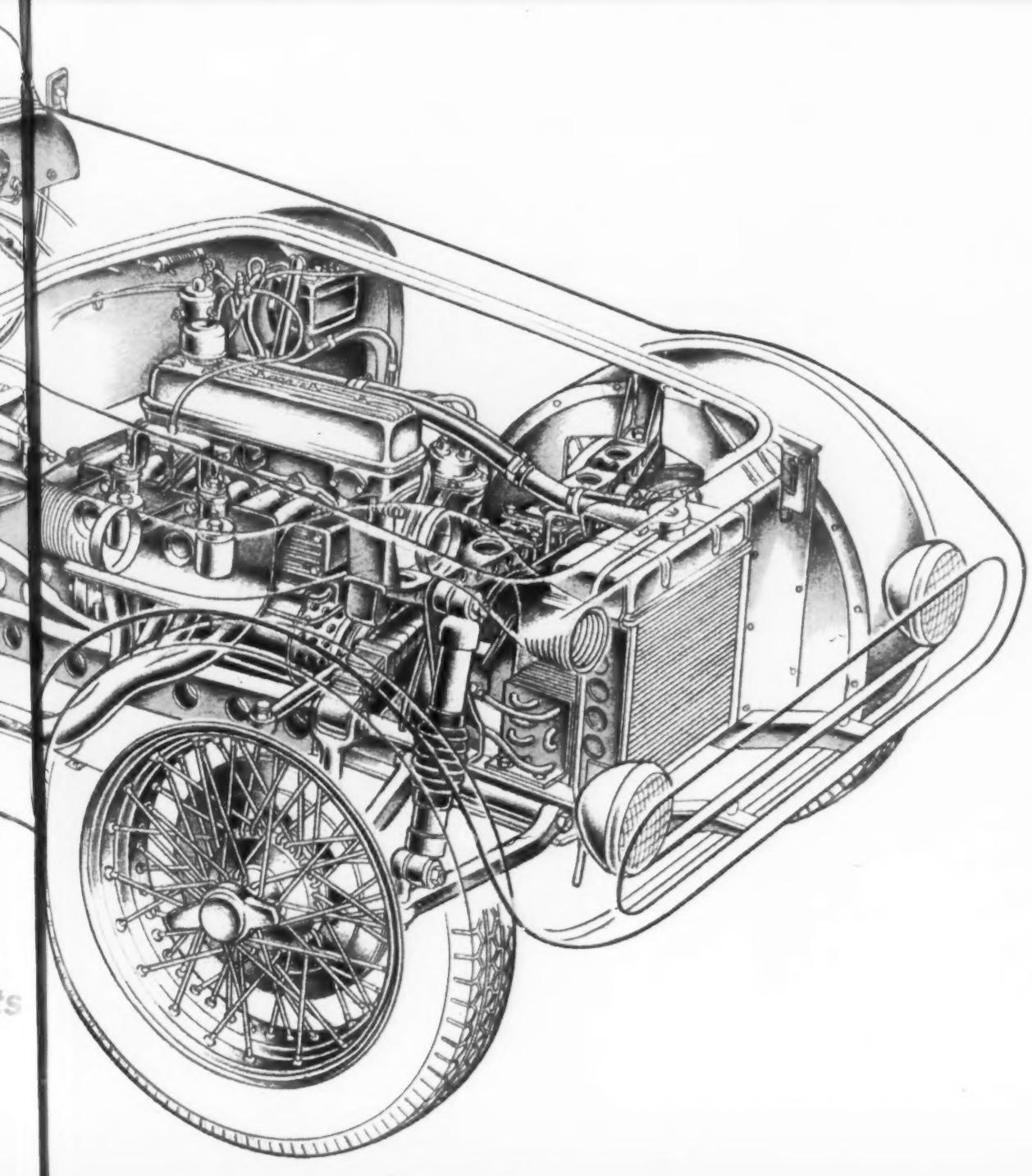
Wheelbase	82.5
Front tread	46 in
Rear tread	45 in

OVERALL

Length	138 in
Cowl height	33 in
Curb weight	1000 lbs
Fuel capacity	8.75 gal

PERFORMANCE

Acceleration	0-60 in approx. 8.5 sec	
Top speed	Timed, 1953	108 mph
	Potential, 1955	118 mph



For three years running Poole has sped his backyard boomer to unmatched victory in modified class H races.

(Continued from page 32)

construction, in the finest Grand Prix tradition. Though it hampers valve accessibility, this approach eliminates head gasket worries and eases coolant passage problems.

In line with current Mercedes-Benz racing engine practice, early Crosley blocks were brazed up from sheet pressings, but this proved impractical in production and a cast iron unit was standardized. Candy uses the later type of CIBA block which incorporates a small divider between the valve seats to promote turbulence. These are bored .040 inch over to bring the displacement right up to 748 cc, while the maximum possible overbore is .150 inch. Removable side plates allow sand removal and inspection of the casting interior around the cylinders.

Another invaluable attribute of the Crosley engine is its single overhead camshaft, which is carried in five aluminum alloy bearings and driven by a vertical shaft at the front. The cams attack the in-line vertical valves through long-skirted thimble tappets and adjustments shims. Standard Crosley valve timing kicks the intake valve open five degrees before top center and closes it 50 degrees after bottom center, giving a duration of 235 degrees. Exhaust timing is symmetrical, and also lifts the valves .235 inch. This provided decent low speed torque with early carburetion setups, but as induction was improved a move was made to a Harman and Collins cam with 20°-60° timing and a lift of .400 inch. With its duration of 260 degrees this is still a very popular stick among the Crosley-powered sports car fraternity, but as Candy learned more and more about breathing and ignition he looked around for means to stretch the useful revs even higher than the limit then of around 7500.

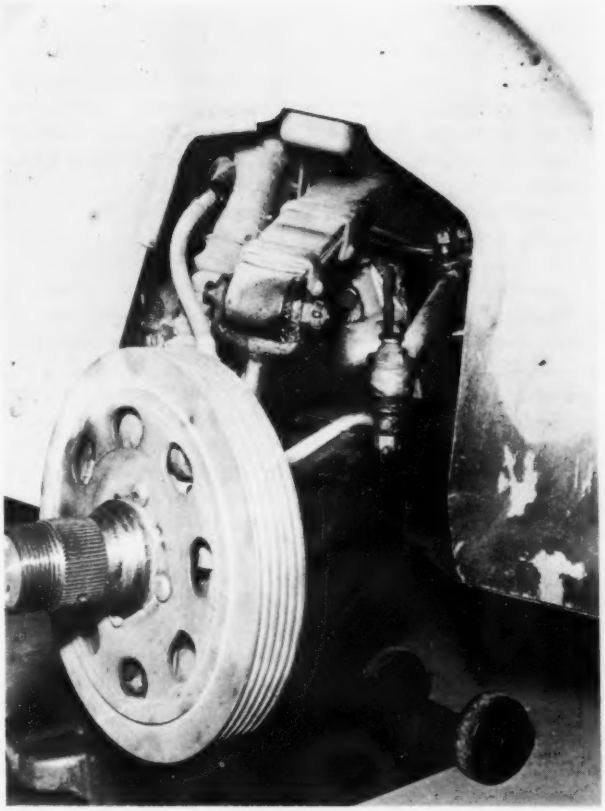
Experiments with hotter H & C and Weber grinds came to naught. So Poole finally worked out a contour that duplicates the opening and closing points of the Harman cam while altering the full open characteristics and reducing the lift to .350 inch. This pushed the output peak up to 8,000 rpm and improved the readings on Candy's dyno accordingly. Valve clearances are set to provide perfect timing at around .014 inch and left there for all occasions.

Borrani wire wheels carry either Pirelli or Dunlop tires. Note exhaust is deflected away from rear tires and into slipstream.

To keep the valves tied down at these speeds, studied return springing is required, and trials with heavy Crosley and special inner coils have yielded a dual-spring setup. All spring sets are fitted with Thompson Rotocaps to improve heat dissipation. Top-cylinder space is extremely limited, and thus far has kept the valves at standard sizes. Candy has a few ideas, however, which in conjunction with the .040-overbore should allow bigger heads to be accommodated. A valve seat angle of 30 degrees was tried but led to burned valves, so the stock angle of 45 degrees is now standard.

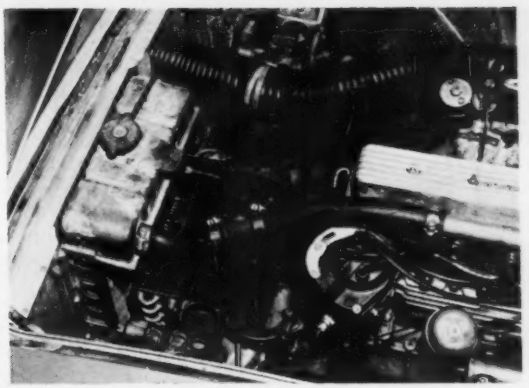
The PBX engine is not particular about its pistons, and Candy says the standard units are fine. At present he is using special cast aluminum pistons with flat tops and full skirts which carry three Grant rings. Compression ratio now falls between 10 and 11 to one, as a result of the overbore.

(Continued on page56)

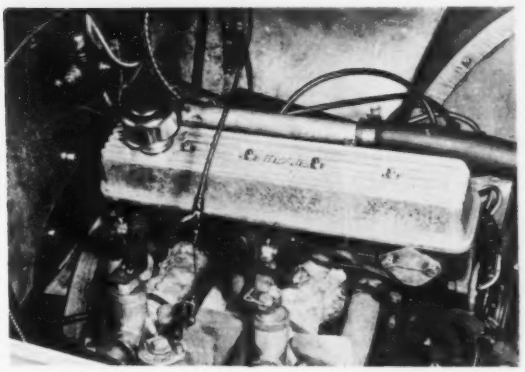


Front suspension remains Fiat in layout with wide transverse spring over two light forged wishbones. Note drums are drilled and finned for optimum cooling of brake shoes.

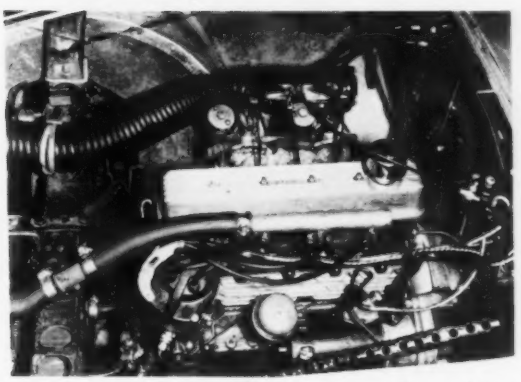
FIA regulations state that all competition cars must carry spare tires among other automobile accessories. To accommodate fifth wheel, the Special carries it behind seats above fuel tank.



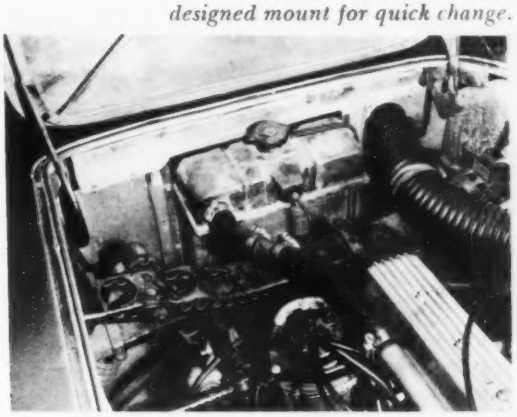
Small oil cooler mounted behind the radiator supplements the big cast aluminum Braje sump.



Twin Amal carburetors feed the potent little four. Equal linkage controls throttles.



The magneto is driven off the crank nose. Gil Knudson designed mount for quick change.



Steering column, frame and cross members were drilled out to lighten chassis weight.

it ain't necessarily stock

By GENE JADERQUIST

Hidden hop-ups threaten to upset production car racing on every level. Here is a guide to what is — and is not — legal.

NORMALLY when a man has an MG in top condition and $1,500 in his pocket he trades for a more expensive sports car. Nobody, except possibly MG, objects to this. A more adventurous soul might keep the MG and put the fifteen bills into a racing fund for himself. This is good, clean fun, approved and sanctioned by everyone except the mink-minded wife. Quite the opposite is the case of the man who spent the entire $1,500 creating the most thoroughly illegal MG ever to enter a production-car race.

The entire sum was so cleverly buried that the car could easily pass pre-race inspections and the usual cursory post-race spot checks. Even when protested, only the most experienced mechanic could detect the modifications.

For all I know the car is still running — and still winning races. My source of information was understandably discreet. Yet he did say one thing — the owner and the mechanic were surprised, not because the car could win but because it frequently had such a difficult time winning. It was painfully apparent that other hidden hop-ups were running as production cars.

Technical inspectors are almost helpless to prevent this. It is prohibitively expensive and time-consuming to examine the entrants, or even the first three finishers, in every production-car event. An effective examination would include stripping the engine and miking everything in sight; reading cam contours with a dial indicator; opening both the transmission and rear end and counting gear teeth; testing spring rates, both front and rear. The mild and swift inspections that are feasible catch only the clumsy or dull-witted offenders.

Herb Welch, chief tech inspector for the SCCA's Los Angeles region, admits: "There are only two ways we catch the hidden hop-ups. The first is when someone lays down the $25 for a protest and we have the engine torn all the way down. The second is when the driver gets carried away with his car. We know that when one MG is passing all the others too easily and too fast, there's something wrong. The presumption is not that all the other MGs are bad, but that the victorious one is too good."

This problem of illegal modifications is as old, and as widespread, as racing itself. As early as 1908 the AAA ruled the entire Buick team off the tracks because they were non-stock, a decision that culminated in a screaming argument between William C. Durant and the chief of the Contest Board. In today's NASCAR stock circuits, officials have been forced to impose increasingly strict penalties on offenders. Where there's money involved, as there is in professional racing, the motive for cheating is clear. In sports car racing, and in such other amateur motor sports as hot rodding, it is not too clear.

This year the officials of the sports car clubs are trying to modify their regulations governing production sports cars to simplify the problem. They admit, now, that they got the whole thing almost impossibly snarled by permitting modifications to bring the cars up to date. The SCCA has now re-defined that to permit modifications up to October 1, 1955. To take advantage of factory changes after that date, you'll have to buy the new model.

Another troublesome regulation is the one permitting the owner to use optional equipment if supplied by the factory at no additional cost. Even with America's mass-production stock cars such rules have resulted in recriminations, accusations, and wild confusion; with European cars, many of which are barely able to qualify under the 500-or-more-per-model rule for production car events, nobody is quite sure what is or is not stock. Porsche camshafts are one example. No tech inspector I talked with could list the possibilities.

Above all this is the indisputable fact that an honest, top-grade, production-class competition car is one of the most expensive and difficult things in the world to build. I'm personally best acquainted with the Mexican Road Race Lincolns, stock class winners for three consecutive years. The Ford Motor Company hasn't released figures on the net cost of raising each Lincoln from its assembly-line status to that of race-winner, but a conservative estimate would be $10,000. Add this to the original cost of the car and you'll find it will set you back a good Ferrari price to buy a top production car. Bringing an MG or a Triumph or a Jag up to this level isn't as expensive, but it does cost considerably more than the average owner can invest. So whenever a distributor, dealer or factory team goes into a production race with professionally prepared cars, the average car-owner — and it was for him that the production class was emphasized in this country — has about as much chance of bringing his home-grown job in ahead of the team as he has of beating a Ferrari.

The temptation to fudge a little on the rules is therefore strong. The logical beginning is to do as much as can be done legally, then pass on to the serious work.

Legally, you can rip the whole car apart and start from there. In the engine, the first step is to go out of the maximum allowable overbore — .030 of an inch over in SCCA national events, anything up to .060 with other sports car organizations. Thirty thousandths of an inch may sound like nothing, but it makes a difference in brute torque. In production-car racing, the tiny difference becomes great.

The rest of the engine work is all relatively insignificant. Insignificant, that is, when compared with the results of trank and open hopping up. The bearings are loosened slightly, and evenly, by grinding the crankshaft. The pistons are loosened slightly by grinding. This frees the engine and keeps it from losing too much horsepower to friction when it gets hot — and in a race it will get hot. All engine parts are statically and dynamically balanced. Combustion chambers are measured to the precision limits of the mechanic's tools and ability, then evened out to precisely stock compression ratio.

Competition Regulations

Production Sports Category — Production sports cars are defined as standard sports cars which have been series produced in quantities of at least 500 per model sold, burden of proof for which shall be with entrant. Such "minor modifications" as trimming fenders, removal of air cleaners, wire wheels, etc., make a car ineligible for competition in the Production Sports Category. #

Perfectionists also check each valve spring and maintain steady, and maximum tension throughout the engine. Valves are hand-lapped for perfect seal. The factory gives you all the carburetor needles, jets and venturis you need, so it's up to you to experiment with them and use the proper sizes for the engine, first taking into account such small items as temperature, humidity, altitude. The rest of the induction system is left to the manufacturer, except that you are permitted to match the intake ports in the head with the manifold outlets.

In the exhaust system you can try your hand at tuning. Two things here. Your efforts will be less than satisfactory because legally you can't play with the header or headers. Your modifications are limited to the area from the muffler rearward. The muffler can be removed, but that is all. You should try to tune, by the way, for the least back-pressure in the rpm range you're going to use — not, as many do, in the attempt to hit the horsepower peak right on the nose. Most of your driving will, or should, be done in the range of the torque peak rather than the horsepower peak. Tune the exhausts to this point.

On the legally stock machine, the rest of your job involves selecting the correct rear-end ratio (if listed by the factory as optional equipment) for the course; in freeing the wheel bearings; in bringing the clutch and brakes up to their peak efficiency; in taking advantage of all the body modifications (removal of windshield, etc.) within the law of the sanctioning group. With the SCCA this includes removal of bumpers, replacing windshields with aero screens, removal of all gadgetry not part of the basic car.

All these legal modifications and improvements may sound silly. They're not. On the Mexican Road Race Lincolns, the expert work permitted top speeds of almost 25 mph over the top speeds of a good stock Lincoln. You'd be surprised how much stock horsepower is lost overcoming excessive friction, compensating for an uneven engine, trying to pull incorrect gears.

With these legal modifications done perfectly by exceptionally good mechanics, the team cars entered by factories and distributors can wipe up everything in the field. This isn't enough when two or more factory teams are entered against each other. At this point the mechanics get a notch ahead of the contest boards and invent modifications not yet covered by the rules. One sterling example concerned oil filters. Mechanics reasoned that the oil capacity of a car could be effectively increased by using a huge, one-quart oil filter. This greater oil capacity kept the oil cooler and lengthened the time between pit stops for oil additions. Then another mechanic mounted the huge oil filter in a finned casing and set the entire thing right in the slipstream of cooling air. Now the car had both greater oil capacity and good oil cooling. Both modifications are now illegal.

Tonneau covers are another example of this ingenuity. A tonneau cover effectively reduces the wind drag of the car and thus adds to the top speed. These are now illegal under SCCA rules.

The list is long. Aircraft batteries, much lighter than auto types, were used. Generators were gutted of brushes so there would be no drag. (Now you can set the voltage regulator for minimum output but you can't remove anything.) Louvers were cut in hoods to aid cooling. Piston ring gaps were cut for minimum friction loss. All these things have since been declared illegal in the production categories.

As the contest boards of the sports car clubs blocked the mechanics' moves, the fight became dirty. Up came the man who spent $1,500 cheating, the factory teams that were going faster and faster with the same cars, the miserable, lonely amateurs who tried to get away with the most blatant forms of modification. Each time someone got caught a new wrinkle was added to the story. Each time someone didn't get caught, the illegal operators were encouraged.

Today the situation is such that, as one mechanic said, "You can't win a major production-car race honestly."

So . . . . .

Watch an inspection crew at work. One man checks suspension for safety and conformity to stock. He jacks up the front end and shakes a front wheel; he crawls under and looks at the springs; he examines the shocks. In the rear he checks the same items and also scrutinizes the differential housing to see if it looks different than stock. Another man is busy in the engine compartment. He knows the kind, size and number of carburetors you're permitted; the details of the electrical system; he even can estimate head gasket thickness and the height of the head above the gasket. If there's any question about the latter, a measurement from the top of the head gasket to the top of the head will give the answer.

Now the spot checks. On one car the inspector will pull a spark plug and measure the stroke of the engine. Another gadget can measure bore through the spark plug hole. If these are OK, the rocker cover can be pulled and the valve springs checked visually. A dial indicator attached to the pushrod end of the rocker arm can quickly check valve lift. And that's just about as far as you can go without pulling everything down.

From observations like these you can compile a list of don'ts. Don't mill the head to increase compression ratio because head thickness will give you away. Don't put shims under the valve springs to increase tension because these can be seen. Don't use a highlift cam because it's too easy to spot. Don't bore or stroke over the allowable limits. Don't buy special shocks or substitute heavier springs or install racing brake drums.

What should you do? If you're a good boy, nothing. It's not whether you win or lose, and all that. But if you'd like to hear what others have done . . .

Easiest and best, according to one good mechanic, is to use an illegal rear-end ratio. Production sports cars are generally designed for street and highway use, not for racing. They carry a choice of gears to cover all normal contingencies, but none designed particularly for, say, Pebble Beach. All other things being equal, a set of Pebble Beach gears will win the Pebble Beach race. To the highly-practiced eye and ear the performance of the car will be slightly suspicious, but nothing short of a tooth-counting and diameter-measuring session will furnish proof.

While on the subject of gears, we might as well mention the driver who not only ran an illegal rear end but a special transmission as well. He had his rear-end gears made up by a machine shop. At the same time he had the shop cut a special second gear for his transmission. This gear was noticeably higher than the stock second gog, so high that the ratio between second and third now equaled exactly the ratio between third and fourth. Coming out of tight corners he had so many more useful revs in second he pulled away from the stock-geared cars. There are only two methods of catching this unusual, and expensive, method of cheating. You can open the transmission or you can run the rear wheels on a dyno and check horsepower against rpm in all gears.

On cars with independent front suspension and coil springs, the front springs can be stiffened. Use the stock springs as a pattern and have a special set made up. Spring tension can be varied by using special steels or using different tempering techniques. On any car, the stock shock absorbers can be rebuilt to give 50-50 action. The special springs are almost impossible to spot without removing them and giving them a compression test; the special shocks are easier to detect, but it takes experience.

Most of the fun is inside the engine. Instead of milling the head for higher compression, you mill the block. (Not that you're going to do this, but if you do be sure and see that the piston doesn't hit the head gasket.) No outside measurement will catch this, and only an old pro who knows the engine intimately will see that the pistons are sticking up 1/16 of an inch or so higher out of the block at top dead center. Some tech inspectors run a compression pressure test, but this is not infallible. Unless the compression ratio has been jumped severely the increase in pressure won't be high enough to convict you on the spot.

With valve springs you can work the same gimmick used on front suspension coils. Get tougher ones made up from the same diameter stock as furnished by the manufacturer. Valve lift is dangerous to trifle with because it's so simple to measure, but the safest, and most expensive way to do it is drill a set of blank rockers off center and take advantage of the difference between lever arms. The lift on the pushrod end will be stock and this is where the lift is usually measured.

Valve duration and timing is safer to vary because it can't be measured precisely without setting the engine up with a degree wheel. However, if you must play with camshafts, it would be safer to leave both lift and duration stock and simply change the rate of opening and closing of the valves. To do this, have a cam ground with almost suicidally fast opening and closing. You'll need your illegally tough valve springs to handle the abrupt action. About the only way to discover this kind of special cam is to remove the cam from the engine and run a contour curve on a bench set-up.

Where most of the ambitious outlaws run into a snag is in the vital process of porting. It does no good at all to run higher compression, better valve timing, perhaps special but disguised carburetors (sometimes you can get by the inspectors by using stock carburetors and boring the venturis out to a larger size); it does no good to do all this if the engine is going to choke to death in the ports. MGs, particularly, are subject to port disease. All that can be done legally is to match ports with manifold.

Of course no port modifications can be detected unless the head is removed, but mechanics kept looking for a way to beat a teardown. Today the best bet is to grind out the ports to a rough-grind surface, leaving the port openings almost stock in area but taking huge hunks out of the interior of the head. Then, to cover the grinding marks, they sand-blast the interior. One mechanic claims he can turn out a ported job that won't measure wrong at the opening, won't look wrong in the interior, yet will give the engine racing breathing at high rpm.

Then there is the type of stunt that seems easy to detect but that escapes the eye of the inspector by its very simplicity. Inspectors have already wised up to the "breakaway" fan belt that is designed to snap during the first surge away from the starting line. They are also quick to inspect the too-loose fan belt that makes insufficient contact with both fan and generator pulleys. But they don't ordinarily measure the diameters of the fan and crankshaft pulleys. So a special, small, pulley is installed on the crankshaft and a special, larger, pulley on the fan. If the diameters of the special sheaves are not too far from stock, they'll be hard to detect. The car will gain horsepower formerly lost turning fan and generator at high speeds. It won't miss the cooling because the air stream through the radiator will handle that function. A fan is only essential at low speeds and in traffic driving.

Why is there so much cheating on stock in the production classes today? One major reason is that the penalties are so small. Usually they're left to the discretion of the local race committee and they vary from simply being disqualified for the particular race in which the cheating is discovered to disbarment from racing for another event or two. To the guy who has been beaten consistently by "production" cars he thinks are hopped up, it is worth this small penalty to have the pleasure of beating the other wiseacres at their own game. There is the bonus of having a car that will perform better on the highway and in the city, even if it is disqualified from racing.

Or, as one expert mechanic-driver told me, the whole thing boils down to a case of "you-don't-challenge-me-I-won't-challenge-you." He happens to be an inspector as well as an entrant. He says that when he finds a quiet (i.e. not easy for the average inspector to find) modification, he keeps his own mouth shut but takes notes on the gimmick for his own future use. Only once has he blown the whistle, and that was when he found a Mercedes 190SL with its rear springs bolted down to nothing. This would give the car better cornering but it also was just too much of an eyesore to put up with. This inspector rejected the car at a preliminary inspection, but he noted that it showed up at the race and got in under the wire in precisely this condition. So he promptly figured the hell with the whole thing and went to work to beat the car by better modifications.

He adds a lot of interesting details. Jaguars, for example, have slushy rear ends that keep both themselves and the front ends from racing properly. Jaguar, however, has unwittingly given an assist to the hop-up artists by lacing the rear springs into a friendly boot. So all that has to be done is to play hell with this rear end springing, modifying everything in sight, installing special gimmicks, and then again lacing everything together. Who is going to unlace the wrappings? Not the average tech inspector. The Jag comes out on the course with MG tightness in the rear-end.

Still we're under the let's-not-protest-each-other rule. In the next race, or the previous one, there's the MG with a fuel log that's been blocked off. As you probably know, MG installed this log between the two carburetors to even out the idling. It's nice for street jobs but not for hot ones. So the wise operators jam a block between the two carbs in the fuel log and put the thing back on the engine. It looks stock but the MG won't idle below 1,500 rpm. Sounds just like a hot cam, and adds almost as much as a hot cam at the upper end of the rpm range. This MG driver knows the Jag driver has had his rear-end suspension modified; the Jag driver knows the MG owner has this fuel log blocked in the center. Neither complains. Not even when you can *see* the vise marks on the fuel log.

Then there are the quibblers:

"Who says this head is shaved! I had to take off sixty thousandths to take care of the warps!" "Headers, Hell! They're stock. You've got to shim up these valve springs to get them up to stock."

And so on.

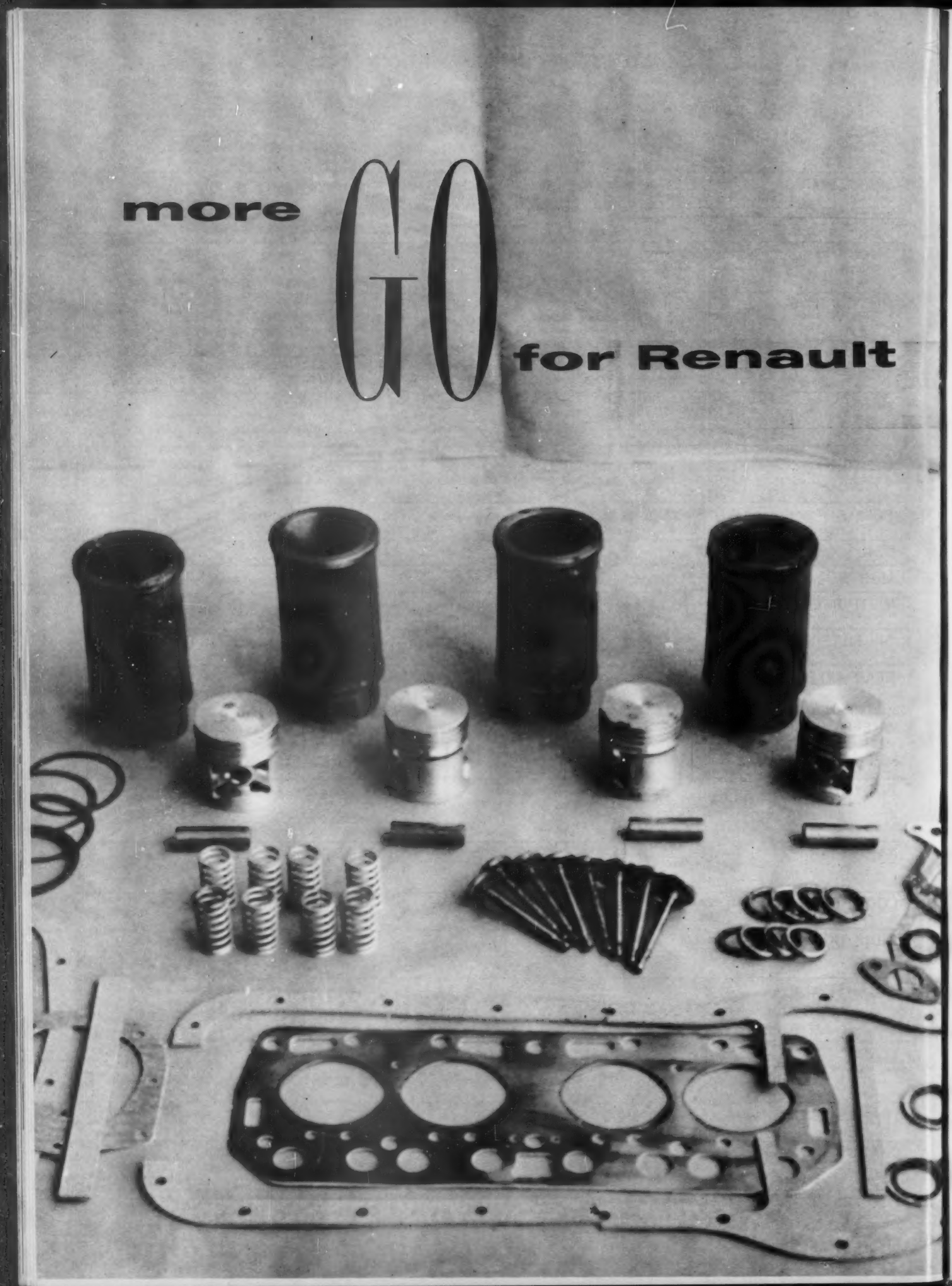
As we said in the beginning of this piece, it is almost impossible to win a production-car race with a stock car. One strong group argues that this is healthy. They claim that both the sport and the science are gaining by the modifications being used. True or not, it's an interesting idea.

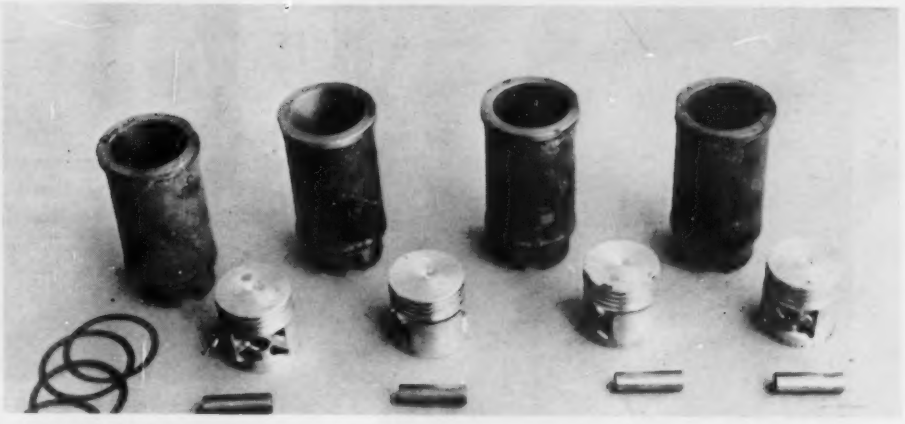
As every racing organization in the world has discovered the hidden hop-ups are with us forever. They're morally wrong, but you can't help but admire the tremendous technical intelligence that goes into their construction. They're a challenge of possibly greater dimensions than building strictly racing machines, since they involve critical assessments of the personalities and capabilities of technical inspectors and curious competitors. The top "production" mechanic builds right up to the borderline between heavy suspicion and actual protest, then stops.

This is what you're up against in the production class. It might be easier just to buy a Ferrari and forget about the whole damn thing. At least you'll be able to live with yourself. #

ALTERATIONS ON PRODUCTION CARS

	Allowable	Not Allowable — Examples
TIRES	Racing tires. Tires of different sizes than original. Tires must be suitable size for wheel.	Asphalt slicks, badly worn tires. Recaps, defective casings, retreads. Unusable spare.
SPARK PLUGS	Dual, multiple, or platinum point plugs — Different makes, special plugs.	Dual Ignition (2 plugs per cylinder) unless original.
BATTERY	Different make. One twelve volt instead of two six.	Aircraft, Motorcycle or special lightweight types.
SHOCK ABSORBERS	Different make.	Different type or design. Reworked (50-50). Adjustable (unless originally supplied).
PISTON RINGS	Different make. Compound or expanding type. Plated or chrome rings. Pistons may be "nurlized" or expanded.	Different thickness. Cutting grooves to different specs.
BEARINGS	Any make of same specifications. This includes plain, roller, or ball types.	Substitution of one type for another — i.e. roller for plain, etc.
BRAKES	Any type of lining.	Drums and/or liners of different specs — Master or wheel cylinders of different specs — Ventilating backing plates or air scoops.
CLUTCH	Any type of lining. Optional springs available from factory at no extra cost.	Special springs or pressure plates. Installation of vents.
POINTS	Any make that requires no alteration to plate or distributor.	Dual points if not originally fitted.
COIL	Any make.	
LIGHTS	Any light conforming to local state statutes.	Lights not conforming to state statutes.
INSTRUMENTS	Any make or type or additional instruments not affecting performance.	Devices affecting performance
OIL FILTER	Any make or type.	Filters over one quart capacity. Filter mounted in slipstream.
REAR AXLE	Ratios from same make and model available from factory at no extra cost. Installation of vents.	Ratios from other models or makes. Limited-slip, Z-F, or locked differentials.
WHEELS	Wire wheels of TF spec. on previous model MGs. Reinforcing plates or devices; 16" wheels on TC MGs.	Alloy or lightweight wheels to replace heavier or steel wheels.
BODYWORK	Bumpers may be removed for races only. Windshields may be replaced by aeroscreens.	Scoops, vents or louvres added. Removal of trim, hardware, or top. Tonneau covers. Austin-Healey windscreen folded.
BALANCING	Balancing of wheels. Balancing of any moving parts.	Counter-balancing. Removal of sufficient metal such as to constitute deliberate lightening.
COOLING	Use of anti-freeze or coolants other than water. Removal of thermostat.	Removal of fan (or any part of) or belt.
INDUCTION	Aircleaner of different make but same type. Matching and cleaning of intake ports.	Different type or "gutting" of aircleaners. Blanking off or addition to induction passages or pipes.
EXHAUST	Straight pipes.	Alteration to any part of the exhaust system forward of the muffler. Systems not sufficiently exhausting gases away from driver.
SEATS	Any seat supplied by manufacturer as optional at no extra cost. Tying down or taping of loose squabs or upholstery.	Bucket or lightweight seats not supplied by manufacturer at no additional cost. Removal of seat squabs or pads.
TRANSMISSION	Vent added to prevent pressure build up and consequent leakage of oil.	Any other alteration.
CARBURETION	Different size needles, jets, or venturis as supplied optional by factory for that model car. Matching of carburetor ports to induction ports.	Special needles, jets, or venturis. Blanking off or addition of, or to, induction passages.
ELECTRICAL	Adjustment of regulator to low output. Removal of "accessory" (i.e. radio, heater, etc.) equipment.	Removal of major electrical components, generator brushes, etc.


more GO for Renault



Wet liners (top row) are sealed at bottom by O-ring gaskets pictured at left. Center Row: pistons. Bottom Row: wrist pins.

By ALEX WALORDY

A LITTLE car that has been almost totally overlooked in this country is the French Renault. Models from '49 to '51 are easily available at from one to two hundred dollars and new parts are also quite plentiful.

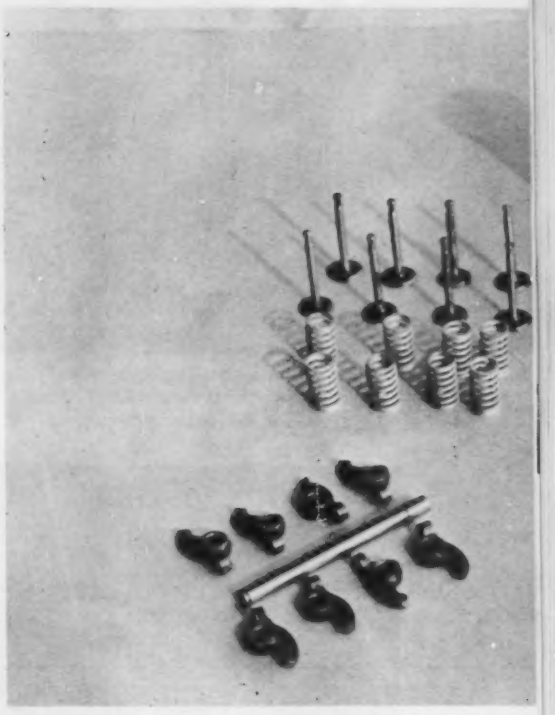
With the same size engine as the Crosley, and a practically indestructible combination of transmission and differential, swing axles, and knee action front, the Renault provides all the elements for a successful, live little number. It will never equal the acceleration of an "88" Olds, but it will corner with the best of them, fit into parking spots you never thought possible, and generally give a good account of itself. And all of this on a 45 cu. inch engine. Besides, competition in this class is not quite as fierce as in the 1500cc group.

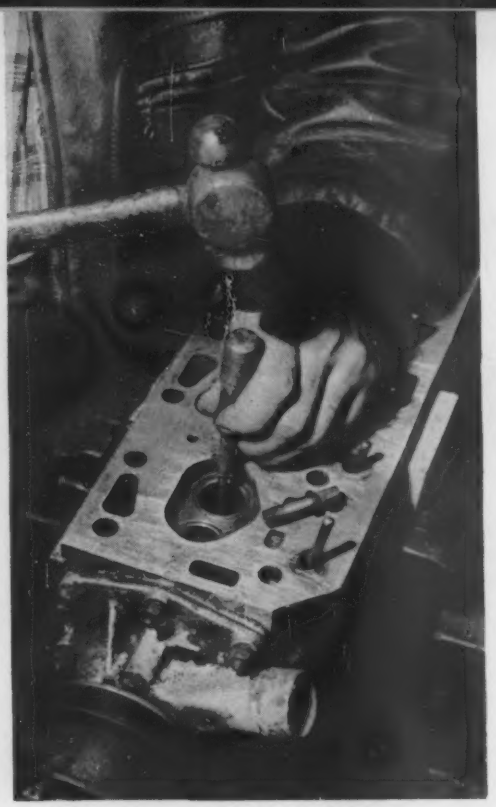
The Renault is widely used in Europe both in stock and factory modified form. Equipped with a "prototype" shell, the modified 1063 ran at Le Mans. In hopped up trim as much as 48 hp at 6500 rpm has been obtained from the stock engine which normally percolates at 21 hp and 4100 rpm. This certainly compares favorably with the Crosley. Considering a weight of 1200 lbs for the car and excellent road handling ability, it can be made into a very desirable little runabout.

The Renault has the advantage of a removable wet sleeve engine. This means that the sleeve, piston, wrist pin and rings are available as a matched assembly from the factory for less than you would pay for just rings and pins for your trusty Ford. Because we did not want to exceed the 750cc Class, boring and stroking were strictly out. This then left plenty of time to work on the head and manifold.

To do the work properly you will need a few items. A Renault shop manual is very desirable and will save a lot of fumbling. A machine shop will be of incalculable help,

Valves, valve springs and part of rocker arm assembly. Unless valves, valve springs, and rockers are new, they should be replaced in order of removal.





Knocking out valve guides with punch and hammer. This leaves room for cleaning, grinding and polishing ports.

and a few metric wrenches will undoubtedly be an aid, especially in the small sizes listed below:

Sockets—12mm (For the L.C. connecting rods) between 7/16″ & 1/2″

Sockets—14mm (For the head bolts, and mains) between 1/2″ & 9/16″

and

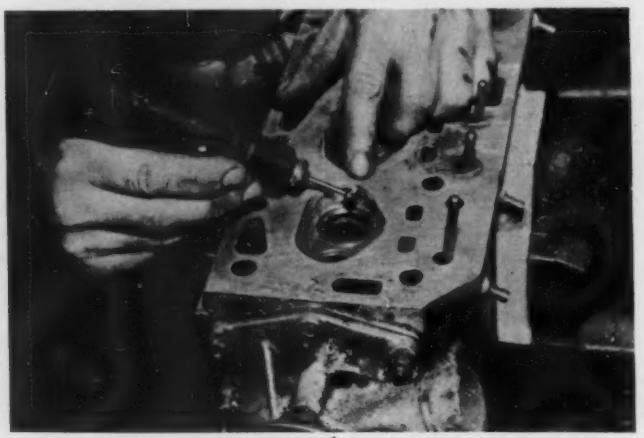
Open end box wrenches 8, 9, 10, 11, 12, 14 mms.

The choice is to buy them, make them, or strip all the bolt heads. All you need for making them are the American size ranges one size below, a good file, and a little patience. We made the wrenches but bought the sockets (Snap-On). American wrenches in 1/32 sizes will fit precisely and cost considerably less than the metric equivalents.

The Renault has a well designed aluminum head that leaves room for substantial detailed development. To start with, pull out the valves and springs. Remove the water pump and the plate opposite it, and clean the head thoroughly.

Next turn out on a lathe, a punch which will fit snugly into the valve guide and a guide inserter by drilling a 5/8

Using a small burr to clean intake ports, mechanic is careful not to dig through the thin walls.

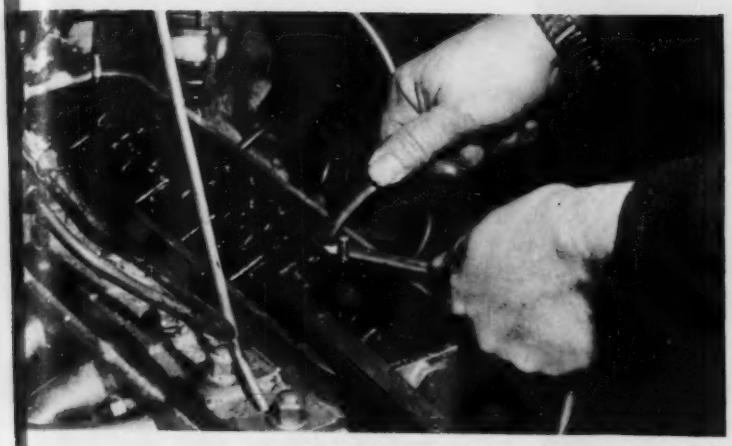


Rounding out combustion chambers with a burring tool. Here the mechanic is cautious not to damage valve seats.

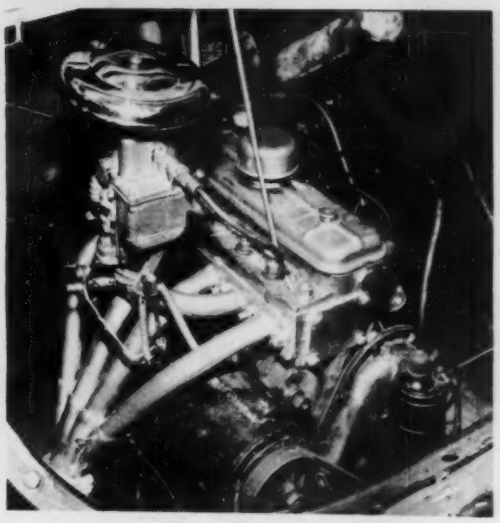
Factory recommended Solex is replaced by a 431 RS Carter. Larger venturi opening helps breathing.

rod with a drill slightly larger than the rocker side of the guide. Do not use a guide remover as an inserter as you risk burring the guide. Remove the guides and run a hone through all the ports, but do not remove too much metal. It is very easy to strike water. Next, get a small burr and continue the clean-up work; round out the contours near the valve guide and at the angle near the valve ports. Try for contour improvement, but retain the original shape and stay away from the water wells. Follow through with sanding disk and emery cloth. Perfection pays off. One thirty-second to one sixteenth of an inch is the most metal that should be removed from any one spot.

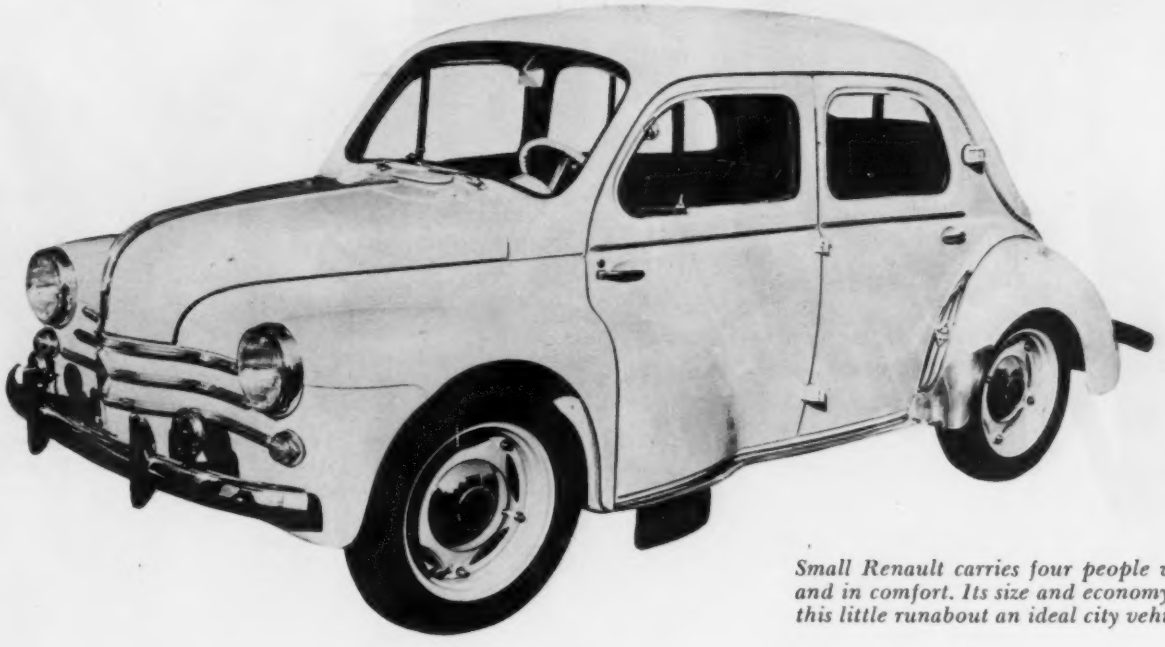
Now let us look over the combustion chambers proper. The casting has channels in it next to the valves to smooth out the gas flow. The intersections of the cut surfaces and the rest of the head should be rounded off with at least a 1/8 radius. The two casting ridges next to the plug should also



Adjusting tappets to .010 straight through. Old wrench with filed out slot fits the adjusting screws. For competition, set .006 hot.



Engine after slight modifications have taken place. Note new manifolding, and larger carburetor.



Small Renault carries four people with ease and in comfort. Its size and economy make this little runabout an ideal city vehicle.

be removed. A good polishing job will complete the task.

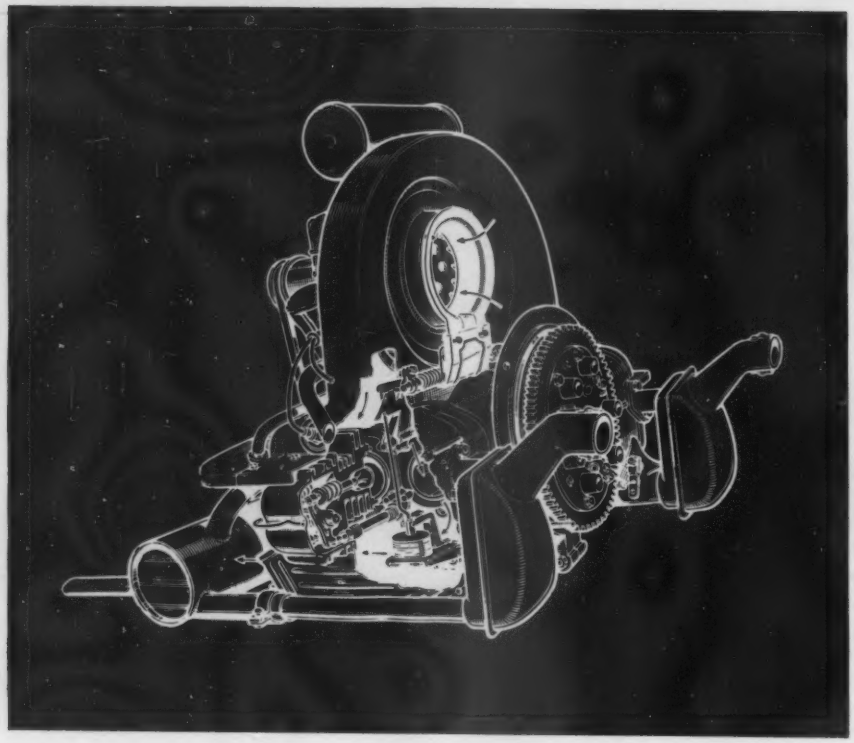
The next operation is shaving the head. It is advisable, however, to first remove rocker arms in preparation for the head milling. The proper amount is .025 on cars later than '49 and .040 on '49s and earlier. The best way is to use a fly-cutter or a miller unless a regular aluminum wheel is available. Do not send it to an automotive machine shop as you would a cast iron head. The combustion chamber volumes are small and a few thousandths out of the way will make a lot of difference. Also a coarse iron stone will rip aluminum to shreds and clog the stone.

One way to set up the job is to lay the head flat on a miller table and take a few thousandths cut to true up the section where the rocker arm cover fits. Then having a true reference plane turn the head upside down and cut the head itself. Try to use a cutter that will do the full width of the head in one sweep.

Now you can install your new guides. Careful! They come in various over-sizes. Turn them down to size first, then install them in the head. Do not bore out the head. We hope you won't be penny-wise and pound-foolish by saving on new valves and springs. The stock installation calls for one shim under each valve spring. We used three shims to good advantage. This is strongly advised when rpm's will be boosted from 4100 to 5500.

We can now reassemble the head and pay some attention to the rocker arms. The factory recommends a $20.00 puller to remove the rocker arm shafts but a good drift punch gently handled will get them in and out like butter. You will

(Continued on page 64)



Cutaway of VW engine shows path of cooling air as it is forced around cylinders, oil sump, and transversely seated muffler.

Vitality for the VW

By RUSS KELLY

IF THERE'S anything in the world that the top brass at Volkswagen has strong feelings about it is the owners who mess with VW engines. The factory has announced, for example, that dual carbs may be fine for the Porsche, but they're no good for the VW. The VW owner's manual bristles with warnings and admonitions that add up to the statement, "You want to soup it? DON'T!"

There are plenty of good reasons for this policy. The little car is known all over the world for its unbeatable reliability and economy, and this is a reputation that the factory does not want to have marred by souping attempts that may destroy the sound, sensible balance of VW engineering.

At the same time, however, not even the most fanatic VW devotee — and there are lots of them — would deny that the car could use some additional power. Innocent passengers are sometimes completely shattered by their first experience with a grimacing, muttering VW driver, rowing his little car along with the gear lever, in mortal combat with a head wind. Or, there's the unforgettable experience of getting out in the middle lane to pass a car and suddenly finding yourself trapped and marooned, without enough acceleration to escape back to safety. Or, there's the familiar VW rolling-country technique of winding the needle off the speedometer dial going downhill in order not to have creep snail-like up the other side.

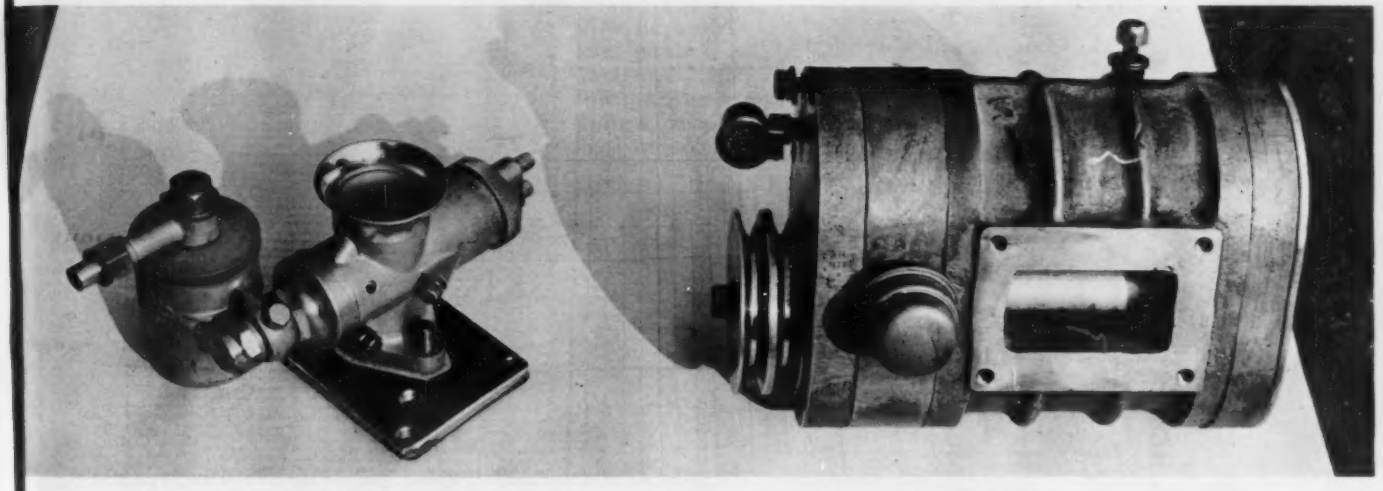
When the VW first appeared in this country many enthusiasts thought it looked like a natural for hot-rodding, but they found very quickly that the engine's designer had done his utmost to outwit them. He had built restrictions

into the engine that are incompatible with high output per cubic inch. The head porting and valve arrangement are enough to make a strong man weep. The valves stand vertically in the heads and are of very small diameter. They *can* be enlarged, but then you're whipped at the ports.

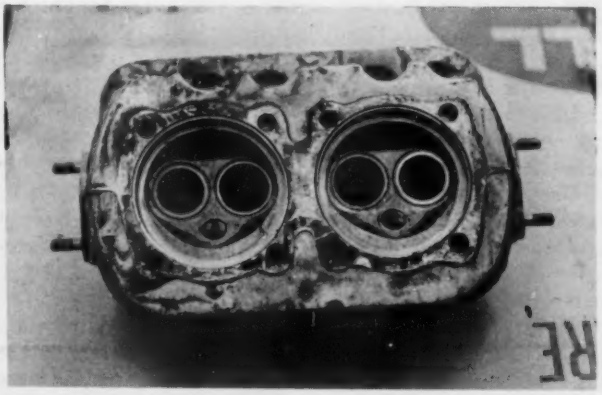
The intake port is siamesed, entering the head as a single port and then branching to feed the two cylinders. Since a single port to each cylinder is generally considered necessary for good volumetric efficiency, standard hop-up procedure is to enlarge a siamesed port throughout and then divide it with a fabricated wall. But on the VW even this simple modification can't be carried out because of the thinness of the metal around the ports. An Austrian manufacturer makes special heads for his limited-production VW-based cars, but their price is prohibitively high.

However, a number of U.S. speed specialists have found ways to make VW souping pay, and they're doing it economically. They're doing it by *ignoring* the limitations of the heads. They're concentrating on (1) supercharging or (2) combinations of valve timing, compression ratios, carburetion, and exhaust manifolding. Either treatment can make of the VW a pretty exciting poor man's *gran turismo* car, with far better torque and acceleration, good road averages, top speed of from 80 to 85 mph — and with *no* adverse effect on economy and reliability.

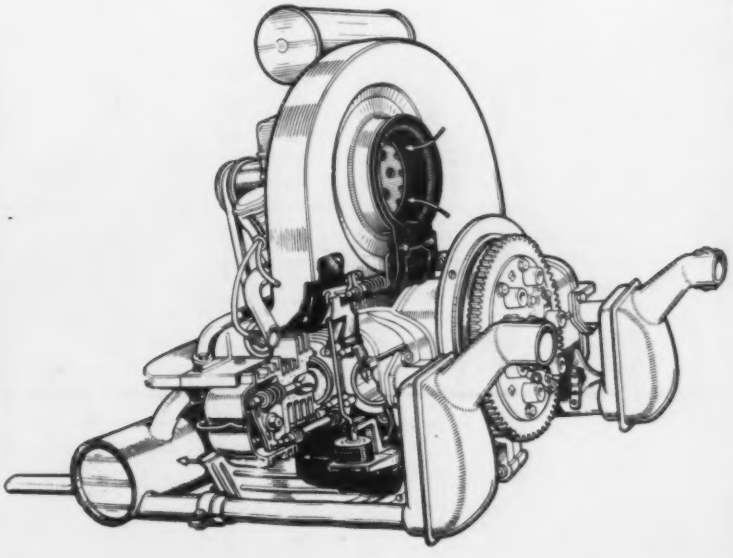
Aside from its built-in throttling the VW engine is an excellent base for hop-up operations, and it is anything but stressed. Engines produced before January of '54 were rated at 25 bhp at 3300 rpm and later models pull 30 at



Pepco three lobe Roots type blower, and a 1-1/64 inch throat diameter Amal-type carburetor. Because of air "slippage," blower is more efficient at upper rpm scale.



Stock head shows small sized valves. Any possible gain made by the installation of larger valves is effectively nullified by barrel spigots which cannot be relieved.



SPECIFICATIONS FOR VW

	BORE	STROKE	PISTON AREA	SWEPT VOLUME	COM-PRES-SION	IGNITION	CARBURE-TION	IN. OPENS	IN. CLOSES	EX. OPENS	EX. CLOSES	BHP
1953	75 mm 2.96 in.	64 mm 2.52 in.	27.4 sq. in.	1131 cc. 69. c.i.	5.8	BOSCH	Single Solex 28 PCI	2 ½ ° BTDC	37 ½ ° ABDC	37 ½ ° BBDC	2 ½ ° ATDC	25 @ 3300
54-55	77 mm 3.03 in.	64 mm 2.52 in.	29. sq. in.	1192 cc. 73. c.i.	6.6	BOSCH	Single Solex 28 PCI	2 ½ ° BTDC	37 ½ ° ABDC	37 ½ ° BBDC	2 ½ ° ATDC	30 @ 3400
1956	77 mm 3.03 in.	64 mm 2.52 in.	29 sq. in.	1192 cc. 73. c.i.	6.6	BOSCH	Single Solex 28 PCI	2 ½ ° BTDC	37 ½ ° ABDC	37 ½ ° BBDC	2 ½ ° ATDC	30 @ 3400
Modified	80 mm 3.15 in.	64 mm 2.52 in.	31.2 sq. in.	1284 cc. 78 c.i.	7.0	BOSCH	Dual Solex or Dual Amal type	19° BTDC	55° ABDC	54° BBDC	20° ATDC	40-45 @ 4400

Abarth dual exhaust system is an excellently engineered piece of equipment. Consensus has it as a must on stock, blown or modified VW's.

Special 80mm 7-1 piston on left slightly domed. Piston on right has concave head and a compression ratio of 5.8-1. Barrel is stock cast iron.

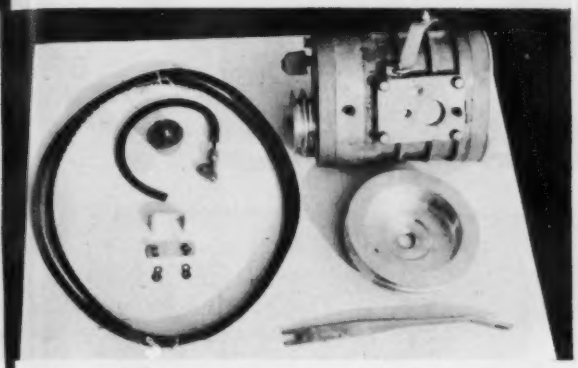
3400. At this crankshaft speed, piston speed is a paltry 1500 feet per minute — almost as low as the power output. With standard tires the 3.5 to one top gear ratio gives a road speed of about 21 mph for every 1000 rpm and a top speed of about 65 mph.

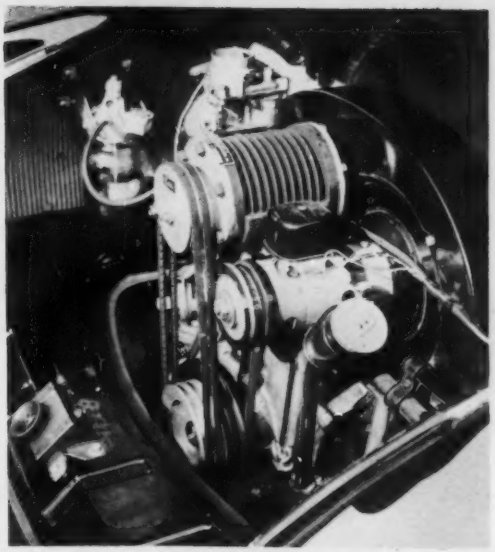
Then engine base itself is of rugged design. The horizontally opposed four cylinders are mounted on a rigid, barrel-shaped, built-up aluminum crankcase. This case splits down the center line of the four main bearings. Mains 1, 3 and 4 are of the bushing type and No. 2 is a split-insert shell. The short, husky connecting rods carry lead-bronze steel backed inserts. The firing order is 1-4-3-2 and out of balance forces within the engine are almost non-existent. All this is reassuring to the owner interested in improved performance.

Probably the country's leading practitioner of factory permitted modifications to VW engines is JEM Engineering of Sherman Oaks, California. Their combination yields an increase in power output of about 40 percent and incorporates most of the major changes possible from the standpoint of practicability. Non-factory-permitted methods can be equally reliable.

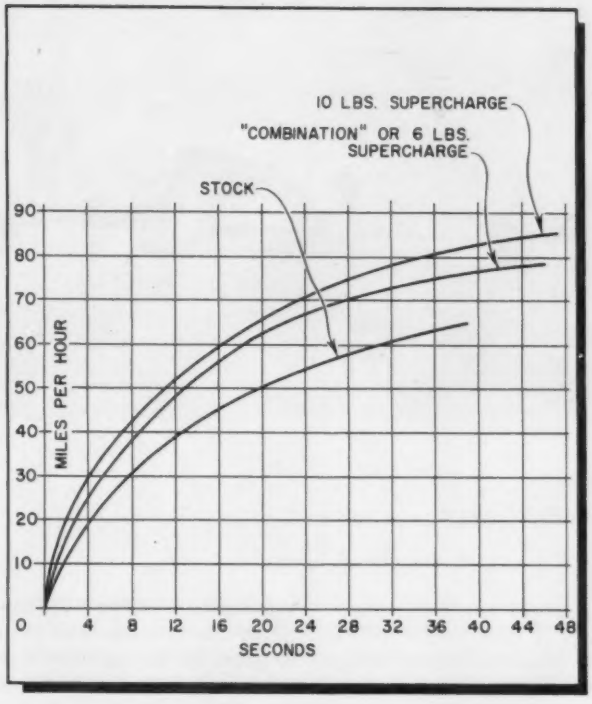
The first step is the fitting of oversize, high compression pistons. 3.15-in. (80 mm) pistons are used in both the large and small bore engines. They bring the cubic capacity up to 78 cu. in. (1284cc) — a seven percent increase for the big-bore job and 13 percent for the pre-'54 engine.

BELOW: Complete Pepco kit is simplicity in itself. Shown here are belts, brackets, crankshaft-pulley and tiny pop-off valve to smother any backfire effects.





The Judson vane type compressor installed using a stock 28 PCI carburetor. The little Ghia coupe accelerated from 0-60 in 15 seconds, half of stock time.



Semi-race cam on left, Iskenderian "404" with radiused tappet in the center, and full race grind on the right. The "404" grind forms basis for VW cams.

The resulting compression ratio is only seven to one. Higher ratios have been tried but without success.

This increase in bore also has the theoretical advantage of increasing the piston area. The higher compression ratio — stock is 5.8 — aids mainly in two ways. First, it improves the pumping action and so improves volumetric efficiency. Second, by compressing the gasses more tightly it increases burning efficiency. All of these advantages, with perhaps the exception of the last, are unfortunately directly dependent upon the rather primitive induction setup. This is where the second factor is introduced and the word "combination" becomes significant. This factor is altering the valve timing.

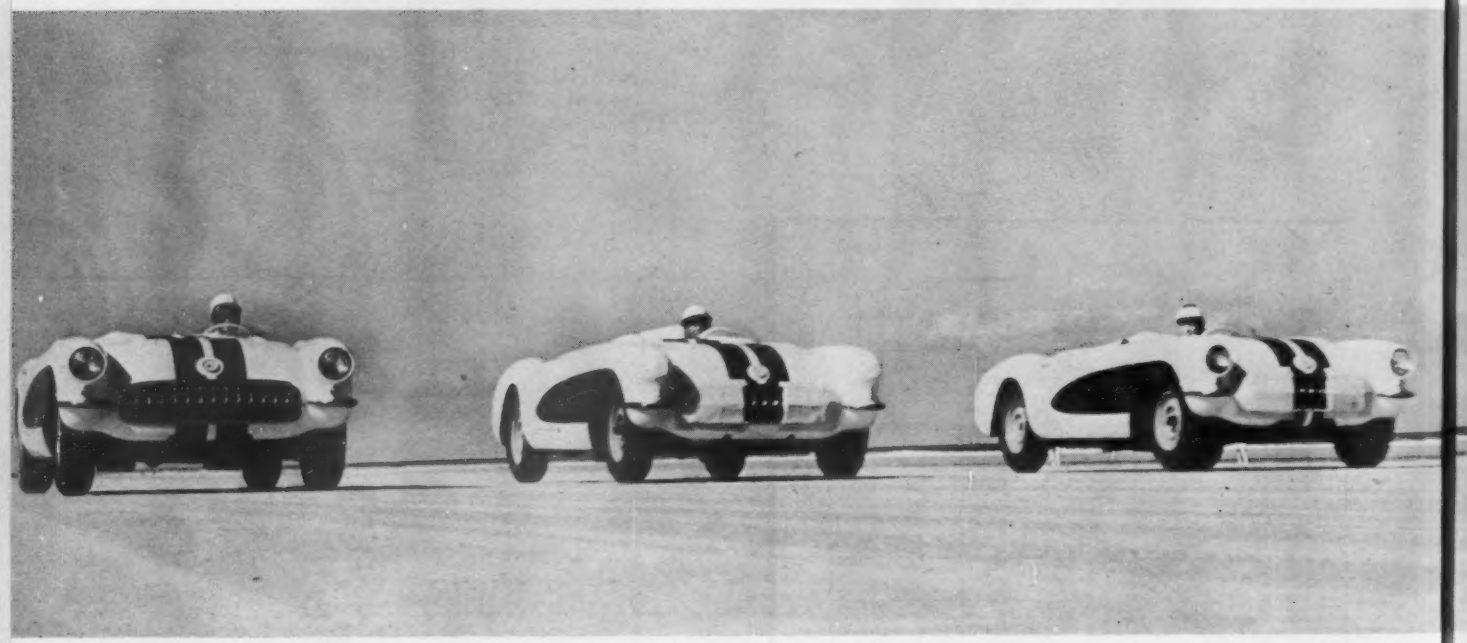
The problems of camshaft engineering are not just confined to the opening and closing of valves. Among other things the all-important consideration of getting the valve to follow the contour of the cam at high engine speeds must be dealt with. The position of the engineer who must face the additional handicap of modifying another man's design is not an enviable one.

Iskenderian Racing Cams of Los Angeles have developed not one but three refinements on the VW cam: a road grind, a semi, and a full-race. Norris Baronian, the firm's knowledgeable young engineer was very generous with hard-to-get information.

He explained that the VW designers, following the dic-

(Continued on page 64)

How fast is the Corvette?



By ROGER HUNTINGTON

WHAT is this *stock* Corvette? After all, 150 mph and a standing mile in 39.6 seconds *on sand* . . . that's Ferrari or Jaguar performance, not the kind of go you expect from penny-pinching American production-line stuff. One can picture everything from fuel injection to a stroker kit under the hood. At first blush, the term "stock" seems just a shade far-fetched. But only at first.

I've done a little nosing around and dug up a few facts (and probably a little fancy!) on the question of Corvette performance. I'm still not prepared to *guarantee* anything in regard to the stock status of the 150-mph factory Corvettes, but here's the story for what it's worth . . .

In the first place, nobody who knows hot road machinery today will argue the fact that the new Chevrolet V-8 engine produces more horsepower and torque *per cubic inch* than any American production engine in history. At 265 cubic inches, it will actually out-perform many OHV V-8's with well over 300 inches. We don't need to take the word of a factory dynamometer operator for this. An afternoon at any drag strip, or a few runs against a stop-watch, will show quickly that here is one of the hottest production engines in the world — *regardless of piston displacement.*

I have even cross-checked by road-testing with an accelerometer. Here we use the mass of the car itself as our dynamometer, read the actual rate of acceleration at various speeds on this instrument, and with these figures the horsepower curve of the engine as installed in the car can be calculated with fair accuracy. Here are some eye-opening comparisons, both calculated from personal accelerometer tests on strictly stock, un-reworked cars with no special tuning:

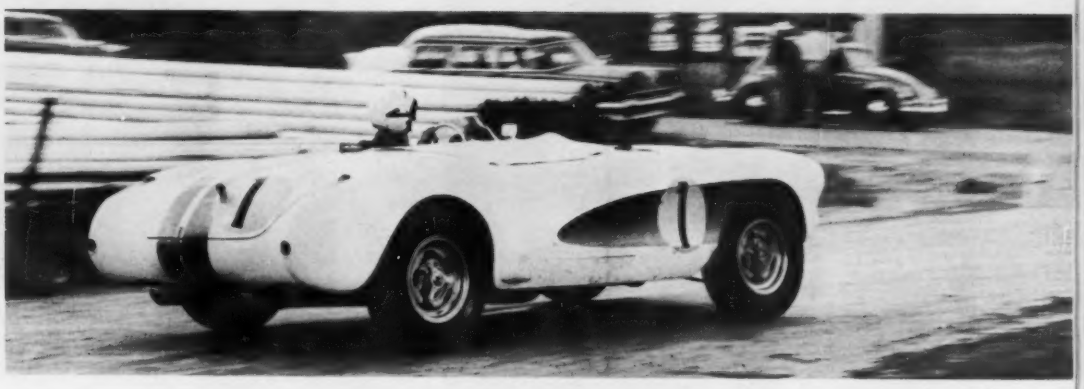
'56 Packard V-8 in Studebaker Golden Hawk (rated 275 hp):
Maximum hp: 215 @ 4400 rpm
Maximum torque: 320 lb.-ft. @ 2500 rpm

'56 Chevrolet Corvette (rated 225 hp):
Maximum hp: 220 @ 5400 rpm
Maximum torque: 225 lb.-ft. @ 3400 rpm

(Admittedly, this was an exceptionally hot Corvette engine — but it was definitely stock. The average peak hp would probably be nearer 200.)

LEFT: Corvette team at Daytona. NASCAR allowed use of the Duntov competition cam. BELOW: At Sebring, Corvette's high torque placed it first at start, but couldn't keep apace.

Firestone "Bonneville" tire used by Corvette at Daytona. Note thin tread layer and smooth side casing.



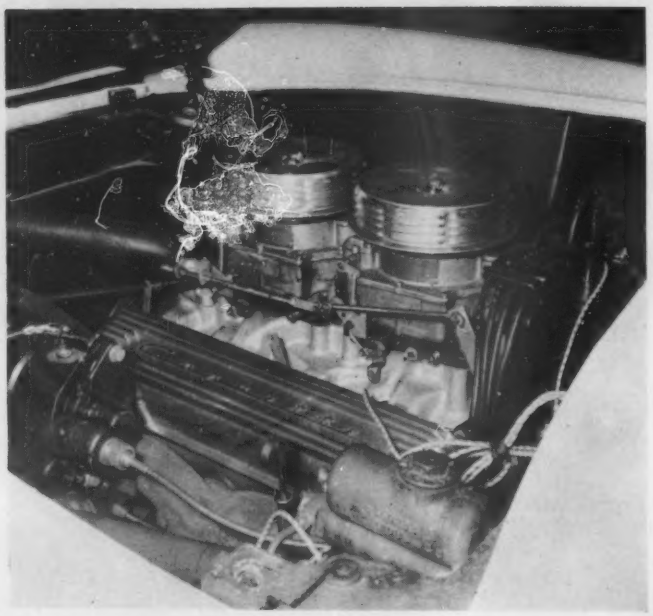
Now I don't know why the Chevrolet engine performs this way . . . and I don't know anyone who does. I've talked to engineers, hop-up experts, and competition men; no one has any half-way reasonable explanation for the unusual performance. It's as much a surprise to the Chevrolet engineers who *designed* the thing as it is to the people who are out beating the big-inch devotees with it. The engine was designed primarily to be mass-produced for a few dollars. By some crazy trick of fate it *goes*.

So let it be firmly established at this point that we do definitely have brute horsepower available in the '56 Corvette — not just advertised horsepower.

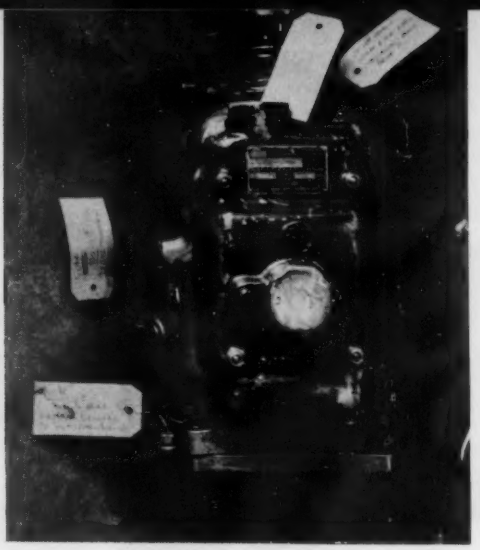
And there's another angle to this horsepower problem: Several weeks before Daytona Chevrolet's engineer, Zora Arkus-Duntov (of Le Mans, Allard, and Ardun head fame), designed a special "competition" camshaft for the Corvette engine. It has approximately the same timing and lift as the standard cam, but much faster opening and closing rates. Official dynomometer figures on the combination have not been released; but Duntov says the peak of the curve on it will average about 240 hp at 5800 rpm. Maximum torque is slightly below the standard 270 lb. ft., but comes in at 4400 rpm instead of 3600. Approximate power curves for the two cams are shown in the accompanying graph. The new cam is characterized by a very flat peak in the 5000-6000 rpm range, without a radical drop-off in power at low speed.

This competition cam was in all the factory Chevrolets at Daytona — and the deal apparently satisfied NASCAR stock class rules requiring 100 cars to be consigned to dealers prior to February 1st. It is optional on all Corvette engines now, including those installed in sedans. Ask for the Duntov cam — (but don't try to balance a coin on the hood when it's idling!).

Then there was the well-known modified Corvette at Daytona. There were all kinds of wild rumors about what this had in it. Actually, Duntov tells me this move was merely to let Corvettes compete in one additional class in the Speed Week festivities, or the class for modified production sports cars. The only change was a set of experimental cylinder heads with 10.3:1 compression ratio. They added about 15 hp to the peak, or something around 255



Three of the four Corvettes entered in Sebring had standard 240 hp engines shown here.

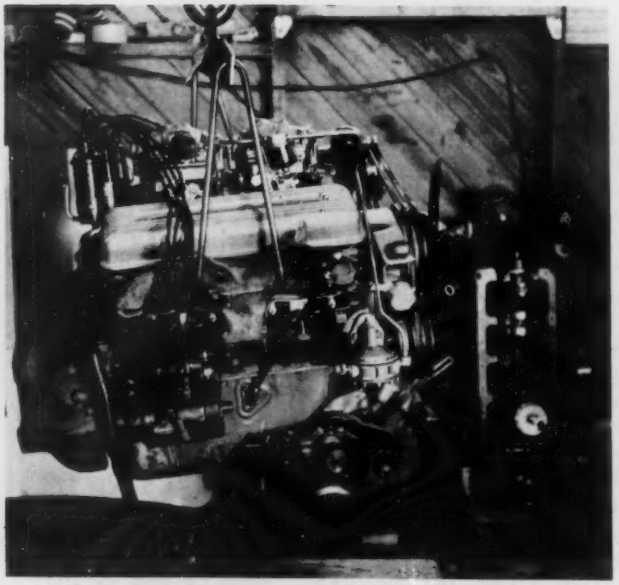


German ZF four-speed gearbox was used in the modified Sebring machine. Extra gearing helped place car in first 10.

Of the four Corvettes entered in Sebring two finished: number 1 driven by Fitch and Hansgen, and number 6 above.

Corvette's brakes were over-sized cera-metallic Bendix units. Primary shoe has two bonded surfaces, second shoe four.

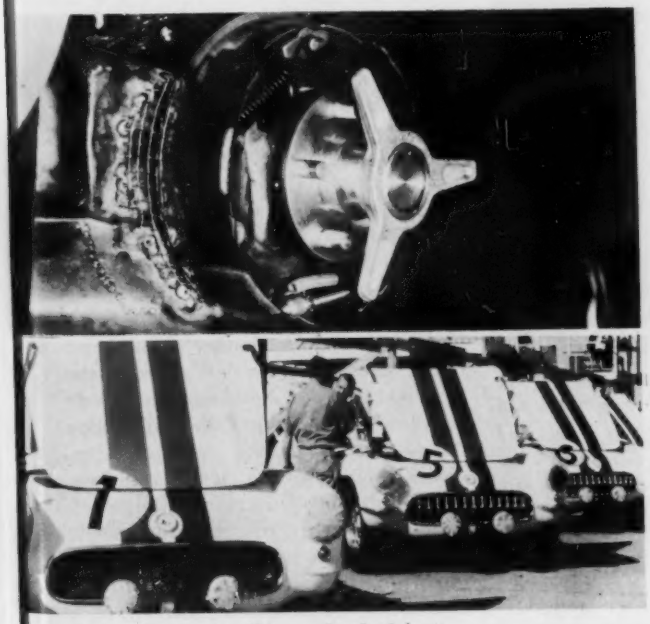
Three-quarter rear view of the Corvette at Daytona. Faired headrest fin increased top speed by 1½ miles an hour.



Stock Corvette power plant produces more horsepower per cu. in than any American production engine in history.

"...here is one of the hottest production engines in the world - regardless of piston displacement."

BELOW: Among other changes the Sebring race Corvette was equipped with Halibrand magnesium knock-off wheels.



Last minute details are checked just before Sebring race. Number 1 car had 316 cubic inch engine for class B.

hp. I have no reason to doubt that this was the only modification, as there was very little difference in times between this modified and the standard Corvettes at Daytona.

Of the four factory Corvettes sent on to the Sebring 12-hour race, three had the standard 240-hp engine described above. Other changes included Halibrand magnesium knock-off wheels, special shocks, and special oversize brakes (wider, same diameter) with Bendix cera-metallic aircraft linings. (All this is to be optional equipment). The fourth Sebring car had all the above, plus a 4-speed gearbox and special 316 cu. in. engine to put it in Class B. Very little information is available on this car. Duntov laughingly refers to the engine modification as a "California tune-up," but wouldn't give any details. The implication, of course, is a big bore and stroke job, additional cam, complete cylinder head reworking (oversize valves, higher compression, porting, polishing), and special ignition. In view of all the evidence, a conservative output estimate would have to be near 300 hp at 6000 rpm.

The two other key factors in straight-line performance are weight and drag. Weight-wise, the '56 body modifications didn't help matters. The curb weight of last year's V-8 Corvette ran around 2800 lbs. with soft top. Current showroom models are up about 150 lbs., due mostly to the wind-up windows and power top-raising mechanism. The stripped competition Corvettes will curb down around 2700.

Drag is a more important factor than weight when we're after top speed. Open sports cars have a serious wind resistance problem because of the larger suction area behind the upright windshield. Such a car will almost invariably go three to 12 mph faster with the top up than with it down — and frequently a small sports car with the top down will prove to have as much total air drag as a medium-size sedan. (Accelerometer tests substantiate this.) The best solution, of course, is to whip the windshield off altogether, give the driver just a narrow, low screen for wind protection, and cover over the passenger side of the cockpit. This not only reduces the drag coefficient by eliminating the big suction area, but frontal area is also substantially reduced.

This is exactly what they did for the competition Corvettes. No wind tunnel tests were run to determine the improvement, but I would estimate that total air drag at any speed is reduced 40-45% with this layout, compared with a standard Corvette with top down. This streamlining kit is

(Continued on page 66)

Lister's Latest

(Continued from page 27)

In the British Isles there are thousands of young men who want to get into motor racing — only one thing stops them — money. The cost of a sports/racing car is high in any country, but in Great Britain it is made even more difficult by a post-war commodity known as Purchase Tax. This tax is levied on most goods, in varying amounts, but in the case of cars 60 percent is currently added to the manufacturer's catalogue price.

Following the lead of Derek Buckler, another well-known builder of competition cars, Lister decided to market his cars in "do-it-yourself" form for home consumption at any rate. By supplying a kit of component parts in this manner, the buyer avoids payment of Purchase Tax, providing of course that he assembles the car himself.

This proved to be a good move, many cars being purchased and raced by British drivers. Lister obtained the services of an aerodynamicist who designed a wind-cheating body with converging tail fins for the "production" cars, but he continued to enter the works Lister-Bristol with the "1954" body. Tail fins were considered rather fashionable in 1955 and Lister admits to adopting them to be considered up-to-date. He himself designed the bodywork on the original cars.

For 1956 the finned body has been dropped and an entirely new shape has been devised — once again the originator of the car. Functional and rakish-looking it is the result of data gained with the original MG and Bristol-engined cars, and has a notably low frontal area. So low is this frontal area that it is less than that of the better-known 1100cc sports/racing cars of last year — and there were some very small ones.

So keen was Brian Lister on reducing the frontal area to the absolute minimum that he has abandoned his faithful Bristol engine which must have been the most powerful one in the country. Reason for this apparently odd move was that the 2-liter Bristol engine is an exceptionally tall engine due mainly to it's downdraft inlet ports and consequent high-mounted carburetors.

In its place he chose a 2-litre Maserati six-cylinder unit with bore and stroke of 72mm by 80mm respectively. This unit is fed by three double-choke horizontal Weber carburetors which are side-mounted and result in a very low engine. Quite apart from the low carb mounting, the engine is a shallow design anyway, measuring only 22 inches in height without carburetors, one inch less than the 1100cc Coventry-Climax.

Of course the Italian engine cost Lister a considerable amount of money — much more than the Bristol, and he hopes that the outlay will be justified, but of this there should be little doubt. The Maserati has not only decreased the frontal area of the car, it has raised the power-output considerably. Maserati claims 173 bhp and Don Moore has been working on it since it came out of its crate last year, so it can be safely assessed as having gained a few more horses.

The frame of the new car is basically that of the old MG-engined car. Delightfully simple yet extremely robust and rigid, it is, like all Lister chassis a "two-tube" type. This means that the main frame longitudinal members are arranged as two parallel tubes. Material is mild steel of three inches diameter and 16 gauge thickness. Three cross-members of the same dimensions and material bridge the frame, and are welded in position.

Frame construction methods employed on the Lister are interesting and point to the fine engineering standards to which the cars are made. The chassis tube-ends about to be welded are first carefully machined to the correct radius and *then* welded. There is no question of a roughly finished tube being welded, with reliance being placed on the molten weld filling up the gaps. Consequently the strength/weight ratio of this chassis is very high.

Interested bystanders have often asked Lister why he does not change to the now fashionable multi-tube "space-frame." His answer is that final roadholding and handling are the criterion of good design, and as yet none of his clients have any complaints in that direction. His works cars have been driven by Archie Scott-Brown, Stirling Moss, Ken Wharton and other extremely fast and successful drivers, and they have all had nothing but praise for the car.

Front suspension is independent by equal length tubular wishbones and coil spring/hydraulic damper units. The damper units are attached at an angle to steel box-section upright members which are strengthened transversely by the front tubular cross-members. Rear suspension is on the popular De Dion principle with coil spring/damper units again supplying the suspension medium. The very light De Dion tube is located by two parallel radius arms per side and by a bronze block sliding in a vertical guide. Girling disc-brakes 10 inches in diameter are mounted inkboard, close up to the Salisbury final-drive unit which is a stressed member supporting the rear spring/damper units. The drive is transmitted by two short half-shafts with Hardy-Spicer needle-roller universal joints, and there is a variety of ratios available for the final-drive.

Front brakes are also Girling 10 inch discs, but mounted outboard. Steering is by MG rack and pinion and two-piece steering column with steel universal joint. Brake operation is through two hydraulic master cylinders, clutch operation being arranged through a third cylinder.

Knock-off wire wheels are fitted, and once again the Lister machine shop proves its versatility by machining the hubs, including the splines, for these desirable fittings.

The radiator and oil-cooler are fitted to the body nose-piece which is of fully-stressed construction, and is divided into three separate air-intakes. The center one feeds the radiator and cooler, and outer ones direct air to the front brakes. Nose piece and body panels are of 20 gauge aluminum-alloy sheet.

It is obvious that air entries and exhausts have been the subject of much study on the latest Lister. Besides the ones already mentioned there are two noticeable intakes in the scuttle of the new body. These are connected to 4 inch flexible pipes which duct air to final-drive and rear brakes, and carburetors respectively. One pipe bends

to the left of the driver under the dashboard and is connected to an aluminum channel secured to the top of the propellor-shaft tunnel whence it runs the length of the tunnel to supply an air-stream. The other pipe bends to the right of the driver then goes forward through to bulkhead to connect to a carburetor air-box. Two slots in the tail of the body eject the warmed air.

Height of the complete car is a mere 27 inches to top of headrest with driver aboard, and the dry weight is 1175 lbs. With its small frontal area and power-output of over 170 bhp this is a speed recipe.

Replicas of the new car are being built for several drivers, some to have 2-liter six-cylinder Bristol and others four-cylinder Alta engines of the same capacity. In Great Britain, intending purchasers must supply their own engine and gearbox if they are to receive the Purchase Tax conditions, but of course complete cars are supplied if required. #

Arnolt-Bristol

(Continued from page 31)

sengers under the hardest cornering. Leg-room is unusually ample. The seats have five stages of positively-locked adjustment. My height is 5 ft. 10 ins., and with the driver's seat in the next-to-longest notch I was barely able to touch the front floorboard with either foot. In the competition body there are no interior panels to the car's doors. But there is a metal strip about 1½ inches deep along the bottom inside of each door. This adds to the doors' rigidity and also makes a useful parcel-storage area in each door. There's no partition between the passenger compartment and the luggage space at the rear. Thus this space is accessible both from behind the seats and through the rear deck lid.

The A-B's complement of instruments is very complete. There are a big speedometer, a tachometer of equal size, and gauges for oil and water temperature, oil pressure, ammeter and fuel supply. The tach includes a clock and the speedometer a trip odometer. Warning lights are used to indicate high beam of headlights (Italian "warning" style), two-gallon fuel reserve, direction indicator and battery discharge. Controls include hand throttle and automatic mixture control for starting. The pedals are nicely dimensioned and spaced for feet of average size and the hand-brake lever is ideally placed between the seats. The shift lever is long and on the springy side. If you insist on the last word in refinement you can get a special remote shift linkage from Arnolt.

The 96-in. wheelbase chassis is based on a rigid, light, box-section frame with front suspension by a single transverse leaf and upper wishbones damped by steeply inclined, double acting tubular shocks. The rear axle is solid, with its differential housing offset to the right. Suspension is by longitudinal torsion bars, and the axle is positively located by a triangular stabilizing bracket that anchors final drive housing to frame. There are four shock absorbers at the rear and fabric slings to prevent excessive axle travel during rebound.

Steering is by rack-and-pinion that is dead-positive and impeccable. It appears to be completely non-reversible — that is, although the steering wheel directs the road wheels very sensitively, there is no playback from road wheels to steering wheel. The system responds as quickly as the most demanding driver could want. A wheel movement of just an inch or two is enough to execute most changes of direction, and gentle road curves need only a fraction of an inch. The steering has what I consider an ideal amount of fuel — it's slightly heavy even at high speeds. Because of this you can set the wheel on the straightaway or in a constant-radius turn, take your hands off and enjoy the rare experience of having your car "remember" your command long after you gave it.

The A-B is one of the fastest-cornering cars I've ever handled, and this includes many quality road machines capable of far greater top speed. Its fore-and-aft weight distribution is very close to being equal and is slightly tail-heavy. Its tread is wide, its wheelbase short, and its suspension geometry is very stable. Under heavy side loading the rear wheels slide outward just the right amount to permit fast and effortless cornering. At high cornering speeds in big-radius bends the car drifts ever so slightly. Its natural cornering stance is flat and rock-steady and it stresses its tires hardly at all. It tracks true and perfectly at almost any speed. Once you learn not to use too much tiller, you can steer it with something very close to a centaur-like sense of oneness with the mount — especially when you gauge the wheel-setting for any curve precisely in advance, set the wheel with a single motion, and let the car do the rest.

The Bristol gearbox is a near approach to perfection. Its bottom cog has obviously been chosen for racing. It's low in terms of numerical ratio and therefore makes the car slow in getting away from the line. There's a good second lost between letting the clutch out and meaningful forward acceleration. But if it had a higher numerical ratio the engine would peak sooner. You only start once in a race, but there will probably be many times when you can use a broadly useful low-gear range. The A-B's first is good up to 40 mph.

First has no synchromesh, but you can downshift to it with no clash or noise by using elementary Model A Ford double-clutch technique. The other gears are synchronized and can be changed with a delicious degree of silence and certainty if you will make the change "slowly" — taking about one-tenth of a second to pass from gear to gear, while never lifting your foot from the throttle. A similar pause insures silent downshifts. You can make them more rapidly, with less stress on the mechanism, by double-clutching and blipping the throttle with the clutch out.

The brakes are terrific. I pulled a wheel to inspect one of the brake drums and was totally unimpressed by the sight of the simplest sort of non-finned, non-ventilated drum. Yet these brakes are all you could ask for. During our ten-stop fade test they lost not a bit of their massive stopping power. These are brakes to race with — which means they're the kind of brakes you don't mind entrusting with your life.

So let's summarize. In terms of performance, the Arnolt-Bristol is a thoroughbred racing car fit to be stabled with Ferraris and Mercedes. Its acceleration is shattering and any point on the acceleration curve can be reached in a matter of instants. You can get tremendous speed in the space of a few watch-ticks, then downshift and brake and be creeping along in Second split-minutes after you were indicating 110 mph. The engine's power is nothing short of a revelation. It forces you to take a second look at all the scholarly arguments in favor of the short-stroked engine. In terms of hand-work and fine finish on mechanical components, there are few machines in the world that can compete with the Arnolt-Bristol. It's a goer and a winner, a full fledged racing machine that can blow off others far out of its displacement class and worlds apart from its price class. It's a car the enthusiasts ought to be fighting to buy.

I'm thoroughly convinced that you'll find no car with more performance per dollar than you can get in the A-B. It's a Golden Age-type sports car, the sort of combination of fierce racing car and obedient road machine that survives here and there only in the high price-brackets. GB

PBX

(Continued from page 37)

A run on the dyno at 12 to one produced a supremely smooth-running engine, but one "with no guts at all." The standard Supersport ratio seems to remain the best for gas.

Porting is a weak point of the Crosley layout, but is little worse than other stock engines. Siamesed intake porting is in part compensated for by the four-port exhaust, but has led to an exasperating search for the right carburetion equipment. Standard Tillotsons were tried, as were twin Carter 870-S carbs which were better in that they had accelerator pumps. Twin Morris Minor SU's were fitted but proved disappointing at the top end. For some time two downdraft Webers did the job, but through it all Poole had his eye on the compact, straight-through Amal motorcycle equipment.

Due to the totally different requirements of cars and cycles it took some time to set them up properly, and early trials were with Amals somewhat larger than the roughly ⅞ inch bores now in use. The bigger ones were just too much, though, and thorough reworking of the small carbs did a better job. For the future there's a brace of the latest in one-inch Amals stashed away.

Surprisingly with the wild cam in use, the PBX is not fitted with tuned exhausts. It is still running the same welded-up bunch-of-bananas manifold that came with the Weber carbs. Perhaps future revisions will make better use of those four exhaust outlets. Porting? Candy leaves all the block passages just as they came from the factory. The intake "manifold" is fabricated, and consists of two straight tubes connected by a balance pipe. Fiberglas wrapping and aluminum shielding protect both manifold and carbs from exhaust heat. The always-difficult problem of controlling the Amal slide throttles was solved by an equalizing linkage based on a Hillman cable system. A supply of cold air for the carburetors is assured by a large flexible pipe from the screened nose, and no attempt is made to induce a ram effect with this refinement.

Igniting this little firecracker at high speeds is an exacting task, which at first was performed by a modified Mallory ignition system. As development proceeded a magneto was called for, but the regular Vertex had a tendency to shed rotors above 10,000 rpm. Matters looked bleak, until Candy came across a very special piece of equipment. Gil Knudson at Scintilla had designed and patented a magneto and integral control that provides a constant and predictable advance curved both up and down the speed range. Only a few prototypes were made, and Poole was fortunate in being able to sign one out of the laboratory. In use on the PBX, this magneto is advanced well beyond 50 degrees at the engine checkout speed of 7000 rpm.

At one time the stock spark plugs were satisfactory in the PBX, but now the coldest suitable Champion, the J-2, is a bit on the warm side. The snap here is the short reach of ⅜ inch, which strictly limits the rate of heat transfer to the block. Special platinum plugs by BG are being made up to do the job right.

Like the block assembly, the cast aluminum crankcase is fundamentally sound in design but requires modifications for the high speeds and stresses of PBX operation. It carries the crankshaft in five main journals, of which all but the rear 1.500 inch bearing are 1.375 inch in diameter. The three center mains of .870 inch width are supported by simple transverse bulkheads, which received a much-needed boost in stiffness by being nearly doubled in thickness in recent factory alterations. Similarly the factory adopted the early hot-rodding practice of backing up the three center two-bolt aluminum main bearing caps with short steel channels. Two of the eleven block hold-down studs are threaded into the tops of the bearing bulkheads, and thus tie the structure up tightly.

A Crosley forged crankshaft is used, which is available at $135 or roughly three times the price of the alternate cast part. The main journals run at stock clearances while the rod big ends are set slightly closer than stock. Until recently the standard nickel chrome steel rods have been used and have been perfectly satisfactory, but as an experiment the PBX is now running special aluminum rods which cut the individual weight by 25 percent from the standard 9.6 ounces. The splash-lubricated wrist pins are fully floating, and turn without bushings in the aluminum rods. Drilled-out aluminum plugs locate them in the pistons.

Effective doubling of the Crosley revolution range has brought up a host of lubrication problems of the most remote type, which have been solved by hard work and Poole-Bentzinger brainstorming. For example, the drive gears to the front-mounted oil pump would starve and fail at speeds above 7000 rpm, and Candy had to devise a method of providing them with a constant oil stream while still maintaining pressure throughout the rest of the system.

SAE 1040 steel is used for the spiral bevel gears in the vertical shaft cam drive. These are fine if all clearances are properly maintained, but some snags cropped up in balancing out the oil pressures at the top and bottom of the engine. A surprising improvement was effected by reversing the position and thus the grain of the horseshoe shim at the front end of the camshaft. A small oil cooler was added just behind the radiator to supplement the big cast aluminum Braje sump.

The magneto is also driven from the crank nose, and with the standard layout its removal requires dropping of the pan and much interior fiddling. Candy, always in a hurry where the PBX is concerned, got mag-designer Gil Knudson to design a mount that would allow quick exterior switching of igniters.

Dynamometer testing early revealed that the Crosley engine tended to run much too cold for highest output, and it was actually a task to get the level up sufficiently high. Internal block modifications have been coupled with a new radiator, which uses the old Crosley top and bottom tanks of one foot width. Height has been cut by three inches from the stock 13, and the new core has 11½ fins per square inch instead of the old 6 per square inch. Three-port hot water riser is an added refinement.

Engines built to these general specifications have consistently turned out a solid 55 brake horsepower at 8000 rpm on the dyno, and Poole usually takes it to around 8500 through the gears. He's not afraid of ten or eleven thousand on a downshift, though, and once in a hillclimb he shifted from a screaming second gear right into low instead of third by mistakes, and everything stayed together! This figured out at around 16,000 rpm, by the way.

All this urge emerges through a six-pound Harman and Collins steel-faced aluminum flywheel. Clutch troubles, so common in other hot Crosley rigs, have been avoided by rugged design from the start. A TC MG clutch and

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transmission were adapted through a special experimental bell housing which represents the extent of official factory backing of Candy Poole. Pre-PBX efforts used a reworked Austin A-10 clutch with satisfactory, but which would not be equal to the present MG pressure plate in sturdiness and heat dissipation. Spring pressures are moderate, since they are limited by the very narrow thrust surfaces on the rear main bearing. Excesses can even throw off the cam tower gear clearances.

Candy gives much of the credit for clutch reliability to the "Fused Fabric" lining specially supplied by Rusco of Middletown, Conn. These molded wire-base facings are attached to the disc by twelve rivets which are inserted from alternate sides and peened over on countersunk washers. By thus binding lining to lining through the disc, clutch shedding has been eliminated. The TC gearbox has remained as standard and in ratios, weight and strength are perfectly suited the PBX. Now used for starting is a Harman conversion of a GM starter which embodies an overrunning clutch. This is good but too heavy, and a compact little Fiat unit is about to go in.

The old Crosley torque tube drive and single universal joint have been retained and adapted to the Fiat 500B rear axle. Within the defenseless center section of this axle have taken place the kind of bold operations that win races. Poole has a garage full of differential carriers, each adapted and machined to take a given type of gear set, including 500B and 500C Fiat as well as pre-war and post-war Crosley. Cogs from the old two-cylinder Crosleys now and then gave trouble but Candy would put up with them to get their very useful 5.57 ratio. The 500C range provides a 6.00 ratio for Thompson Raceway and 4.875 for the new Watkins Glen course. Once in place in the carrier, each gear set is thoroughly safety-wired and run in on a lathe. The differential and half-shafts remain stock Fiat.

Indeed, in spite of the Crosley motive power the PBX might better be termed a Fiat Special, since it is structurally based on a 1949 Fiat 500B station wagon chassis. All the initial planning was done in chalk on a concrete garage floor, and began with a wheelbase dimension that was fairly arbitrarily set half way between the Fiat and the Crosley Hotshot. New welded plates boxed in the channel side members and were drilled with holes staggered from those already supplied by the factory, while a Z-ing operation just ahead of the rear axle lowered the frame without restricting

(Continued on page 59)

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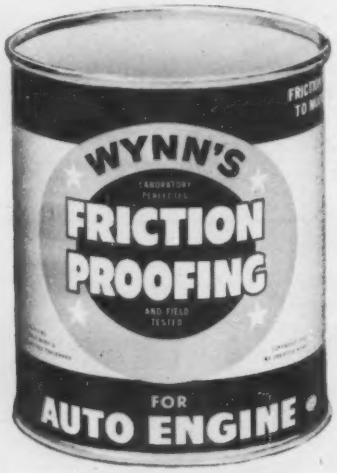

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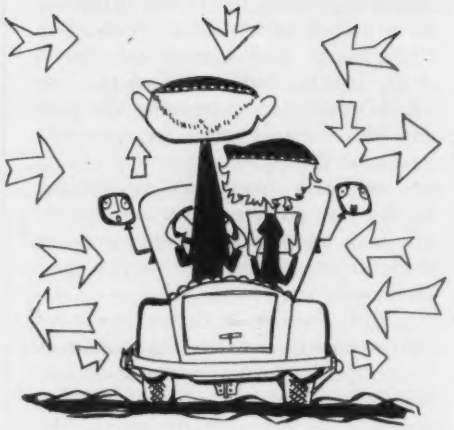


SPORTS CAR RALLIES, TRIALS AND GYMKHANAS

by David Hebb and Arthur Peck

Channel Press

EXPERT rallyists the nation wide will rise up and berate Dave Hebb and Art Peck for what they have done. For years the real secrets of rallying have remained just that, being jealously guarded by those who have labored so hard to find them out. The ignorant natives long have been restless, often either afraid to take the first step or too inept to advance beyond that point. Hebb and Peck have placed the Wisdom of the Ages in their hands.

The book starts out roughly the way you would, explaining the club and rally situations and then leading you through a typical first event. With this information alone you are prepared to make a good start, but the authors then begin again and review each of the rally elements: The averages, clocks, odometers, maps and car comfort, plus some very pertinent remarks on the driver-navigator relationship. A chapter of rally-*winning* tips rounds out the section, and is one, incidentally, which the authors are well qualified to write.

These elements are presented in a style that is unobtrusive when explaining and yet frequently light for a change of pace. They get through the tough average speed chapter very clearly and usefully, though among calculating systems they omit the flexible graph between time and distance. If you think you know something about that mileage recorder on your speedometer, you will still find surprising information about odometer correction and backlash. In short, this one is for the old-timer as well as the novice.

The above would be a handy tome in itself, but more data is forthcoming on the exacting regularity runs and tiring night rallies, plus reviews of the major events. Hebb and Peck then dwell on the tricks of "gymkhana" maneuvering tests, as well as the rigors of true trials and hillclimbs. Their experience even encompasses the rewarding labor of *Concours* preparation, and while properly avoiding active racing includes courses and the art of comfortable race spectating.

Winding up are two chapters on rally planning, with excellent suggestions, check lists and specific rally schemes. Throughout the book there is an impressive and commendable effort to be *specific* about recommended equipment, right down to sources and prices. Due to the size of this continent such information and certain other aspects tend to reflect the book's New York area origin, but not at all annoyingly.

In a very real sense, the competitions discussed by the authors represent tougher, more detailed and exacting interpretations of everyday sports car use. A rally is a controlled highway trip; a gymkhana is a timed, precise shopping jaunt, while *Concours* preparation is a highly exaggerated Sunday polish job. As a result, their recommendations for these events provide an excellent operation and upkeep guide for the sports car owner who has no thought of actively competing. Hints on proper tools, clothes and equipment for touring are part of it, as are general driving techniques and car cleaning tricks. While it is invaluable for every sports car fan, this book should be mandatory for clubs and rally planners. Indeed, the subtitle might be better for the book as a whole: *A Complete Handbook.*

Finally, to this reviewer *SCRT & G* is a sign of growing maturity on the part of the sports car movement in the United States. It is the first major American sports work since the war that doesn't vie for the title of Most Cars Included, and owes absolutely nothing to older foreign publications. The material is all new, all fresh, and all indigenous to the American scene. We have been borrowing from Europe long enough, and Hebb and Peck have been the first to make a significant repayment toward this debt. #

(Continued from page 57)

wheel movement. The existing X-member was split and moved back to embrace the gearbox and bell housing, which are supported by a new hat-section crossmember just below the torque tube ball joint. The front channel crossmembers remain substantially Fiat except for enthusiastic use of the hole saw. Many small L-section channels stiffen the structure and carry seats and bodywork.

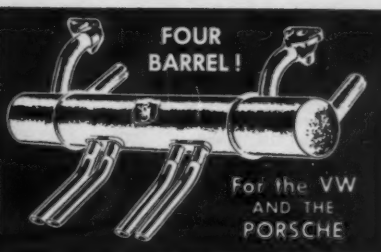
No effort has been spared to make the frame a stiff and consistent base for the suspension, even at the expense of a little extra weight. That this has been successful is indicated by the uncanny sticking qualities of the PBX, which has been tried by experts and proclaimed one of the sweetest handling cars in existence. The answer is again split between good basic design and Poole flexibility.

Front suspension remains Fiat in layout with a wide transverse leaf spring placed above two light forged wishbones. The spring itself has been much modified and heavily wrapped in the center, and by adjustments at the four-bolt center clamp Candy can alter the lateral weight distribution within ten minutes. Angled Columbus shocks with matched strokes take care of the damping.

Wholly standard Fiat worm and sector steering gear and unequal track rod linkage are used. Left hand drive is retained, but be it noted that this provides the most accurate steering geometry for the left front wheel, which carries the burden of control on our predominantly right hand circuits. The steering column was re-angled and drilled out beyond recognition, and is now fitted with a tape-wrapped Nardi steering wheel which constitutes one of the very few non-essential expenditures on the car.

Experience with the old Hotshot helped develop the PBX rear suspension, which as mentioned before retains the Crosley torque tube. Since the Crosley coil springs are also used, additional axle location is required and supplied in abundance. Extending from frame left to the right hub, a Panhard rod handles lateral placing, while small-diameter radius rods run straight forward from each hub to mountings in the lateral plane of the ball joint. On the surface this arrangement is absolutely wacky, since it is redundant in many ways. Assuming tight ball joints and a stiff chassis, any movement of either rear wheel from a static position will produce a bending moment in the axle casing. The angles and distances involved are so small, however, that deflection is never marked, and the resultant effect is that of a very powerful rear. anti-roll bar.

(Continued on page 60)



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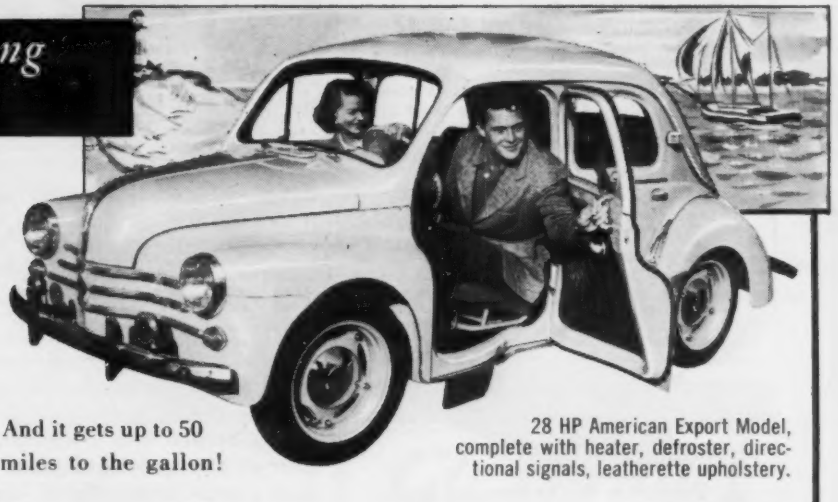

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By MARION WEBER

Hi! This month I'd like to say a word in favor of the seat belt . . . sometimes called safety belt . . . and express my gratitude for the invention of this device. A few months ago I was beetling along the Los Angeles Freeway (A long, narrow parking lot)and had just decided to turn off when I fainted . . . (no, it wasn't the smog, just something near-fatal). My Healey almost made the turn unaided, but not quite, and got pranged proper. I was somewhat shaken but unhurt at the end of the bumpy ride. . . thanks to my seat belt which I fasten at all times . . . even if I'm just warming up the motor for my husband. No joke, I would surely have been thrown from the car during its gyrations and likely have become a casualty had it not been for this ingrained habit.

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(Continued from page 59)

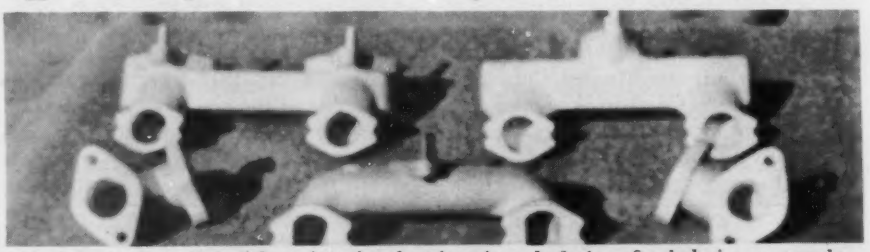
The Panhard rod and radius arms are all fully adjustable for length, and thus allow the rear axle steering effect to be accurately adapted to the course requirements. They can also alter the amount of roll resistance mentioned above. Both these factors affect the steering characteristics of the car as a whole, and together with the front suspension adjustments they allow Candy to set the PBX up just the way he wants it. In fact, his regular practice is to balance it out so that side-to-side weight distribution is 50/50 with his 175 pounds in the driver's seat! This degree of finesse is rare, and obviously pays off.

The only real constructional boner that Candy made was the use of adjustable Ford lever-action shocks in the rear. These didn't do the job and were replaced by Columbus tubulars mounted vertically, which should have been the most effective position with that suspension layout. It was, all right, and to lessen the immediacy of their action the shocks were "sea-legged" in during 1955.

adjustment only at the beginning of each *season*. Actuation is by a Crosley master cylinder.

Borrani wire wheels carry either Pirelli or Dunlop racing tires of very small section, which allow low pressures to be used for traction without prejudicing cornering power. 4.50 x 15 rears are sometimes worn to get just the right gear ratio. The spare is clamped down under the rear deck and over the Hillman gas tank, while the emergency brake system is built up of MG parts.

A balsa scale model went along with the PBX chassis to the Aeroform Company of New Haven, to help Sven Johnson wrap a body around all that hard work. Crafted in aluminum, the results are unparalleled among specials and equal to any manufacturer's prototype. It is full of unobtrusive good ideas, such as the ½ inch laminated aluminum honeycomb firewall, which is cemented into place, and the integral seat pans to augment frame rigidity. Curves, fittings, hinging, beading are all flawless. Baffles ensure that



Poole experimented with various intake pipes & carbs before final choice was made.

Theoreticians will note that the unsprung weight at the back is on the high side, but Candy points out that the overall weight of 1000 pounds is high for that class of car, and the unsprung/sprung weight ratio is thus kept down. He quotes as a contrary example the much-touted Stanguellini, which with a live axle and a weight "sopping wet" of 850 pounds was a real handful on any part of the course.

Many SCCA drivers will admit to having blasted into a corner right to their all-stops-out cut off point, only to have Candy whistle by in the PBX, move over into correct line, and *then* apply the brakes. It is with these potent stoppers that he really starts to menace the class G boys in the later stages of a long race. The beautiful Fiat cast aluminum shoes are used, while the original drums were drilled for cooling and then farmed out to have aluminum muffs bonded on. On their return the muffs were lathe-turned down to cooling fins, and installed over Fren-Do linings. Incredible though it may seem, the *original* linings are still in the car, and require all air entering the low snout passes through either the radiator or the carburetor cool air duct, and a full belly pan smooths off the bottom. Instrumentation is very complete, by Sun tachometer and Stewart-Warner.

That's roughly what goes together to make a PBX. Tempted to get out your pliers and have a go? It's not advisable unless you have the ingenuity to use a bicycle horn to cut weight, let alone the know-how to balance an engine statically and dynamically, or the patience to weigh the shavings when drilling for lightness. In short, unless it says "Chandler Poole" on your toolbox, you'd better try your own approach.

There's an easier way, though, since Candy has announced that he will part with this member of his family for surprisingly little more than the $3500 cash investment that it represents. If it's still around for another season, ther're still those bigger valves, which should boost the output to 60 bhp, and Candy is high on the list for a Crosley fuel injection rig being developed by Scintilla. Let's see now . . . if we exhaust-tune it, and use a little more overlap . . . #

Plucky Seven

(Continued from page 25)

This is far from saying that the Seven is a perfect little mechanical angel, complete with harp and halo. Though savants place it beside the Rolls Royce Silver Ghost, the Brescia Bugatti, and the Model T Ford, as one of the great designs in automotive history, actual Austin Seven drivers will only concede that it's probably the greatest car ever designed on a pool table. Its failings, peculiarities, and perversities; its gift for doing all the right things in all the wrong ways, add up to what people who are comfortably rolling along in something else describe indulgently as "character," and people in Austin Sevens call by other names — few of them printable.

For instance, the study of Austin Seven noises is a science in itself. There is the bloodcurdling wail of the "ham-slicer" starter, which item aficionados will tell you proudly the Seven has in common with the early Bentley. It is the only thing an Austin Seven has in common with a Bentley of any description.

There is the constant jingle of the crank, which in most models was fixed, but not very. There is the steady, unstoppable murmer of the radiator leak, and the clank of the fan pulley, which generally hangs beltless. Normally overcooled, the car runs better that way. Perhaps it's less confusing for the overworked little engine, since when all is connected according to the book, the fan whirls backwards. It's supposed to!

Then there is the rear main bearing rumble. This is probably the oldest design bug in automobile history. Austin Sevens, and the rumble, have been around for 33 years and nobody has figured it out yet.

Fifty miles after an Austin Seven leaves the factory, a low growl starts emanating from the rear main bearing, a disturbing grumble that seldom gets worse, but never gets better. Nobody is quite sure why this bearing should mutter to itself, or, if it is in distress, why it doesn't go further and seize up altogether. The likeliest guess connects the condition with the fact that the skinny, two-bearing 1⅛-inch crankshaft develops a pronounced whip at speed. (On competition specials with shaved heads and thin gaskets, there's no need to shift gears by the rev counter. The driver merely waits until

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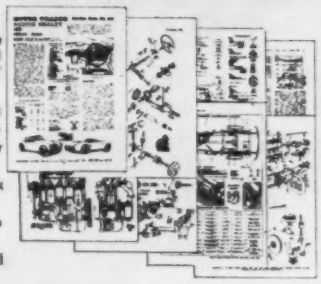

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he hears the characteristic clonk of the pistons hitting the underside of the head as the shaft bows. Then he knows he's in top revs for that gear, and must change up one!)

In the cause of quiet motoring, the Austin company fitted a new and improved rear main, so stiff that it could scarcely be turned by hand. This kept the grumble at bay for 100 miles, but when it arrived, it stayed. In a further desperate effort, the manufacturers put a center bearing on the crankshaft. This nifty device supplied not only growl in various keys, but the exciting stereophonic sound of a fracturing shaft and a jolly tinkle as various innards burst outwards. The Seven-Fifty Motor Club casts their car badges from alloy crankcases that have taken this route to the Happy Hunting Ground. The Club has 2000 members, most of them have car badges, and there's no shortage of metal in sight. As a memorial to a lesser evil, the Goodacre Trophy, Club award for the highest score of the season in the 750 cc formula, is a polished and chromed two-bearing crankshaft — possibly on the theory that anyone who has taken an Austin Seven through a season of racing could probably use one.

When the slide-rule boys decided that the Baby Austin was a miracle of engineering, they had various straightforward features in mind, such as its unconventional chassis, its muscular little engine, and its utter reliability. However, one of the most miraculous bits of mechanical foolishness on the car involves its thoroughly mediocre steering layout. The parts are absolutely standard: steering wheel on top, steering column, and, on the bottom, a worm and gear in the steering box. Now, by some process Sir Isaac Newton must have overlooked when he was figuring out his law of gravity, oil manages to leave the steering box, drip *up* the steering column, and land on the driver's trousers. Nobody has figured out anything to do about this either, except to wear oil-colored pants.

After dripping up, it's a cinch for the highly talented oil used in Austin Sevens to sneak out of the gearbox, crawl forward along a revolving driveshaft — which ought to throw it sideways, if centrifugal force hasn't been repealed — and soak the clutch lining. Austin Seven drivers are continually pulling up at the nearest drug store for Fuller's Earth, an absorbent powder which is dumped into the clutch housing via the inspection plate, to sop up the oil and cure clutch slip.

This clutch is the secret of the Seven's "pep without power." Since it has a travel of only an eighth of an inch, smooth starting is next to impossible. Letting in the clutch generally results in a convulsion that racks the little car

ACTION IN ARIZONA

HOT on the heels of Daytona's Speed Week the public, still reeling from the knowledge that "production" Chevy Bel Airs can do 121 mph, Dodge D-500's 130, and Corvettes 145, was confronted with the results of another festival of speed, this one devoted to products of the Ford Motor Company.

The occasion was the public dedication of Ford's magnificent new 3840-acre proving ground in the desert near Kingman, Arizona. The specific site was one of the proving grounds many facilities — a five-mile asphaltic concrete track with 2500-ft. radius curves banked as steeply as 60 degrees. The timing and certifying body was NASCAR and the first performer was a '56 Ford Sunliner convertible powered by optionally-available Thunderbird Special engine with 312 cubic inches displacement and an output of 225 bhp. This car was clocked at 110.337 mph for the standing-start ten miles and at 118.197 for the flying-start five miles. In all, it surpassed 18 national records, all by broad margins.

Next, 20 existing stock car records were blown to bits by Mercuries driven by Walt Faulkner, Johnny Mantz and Von Thompson. Among the new "records" set by Mercury were 115.207 for the standing five miles, 130.700 for the flying five, and 117.214 for a solid hour.

These Mercs, too, are cars that the public can buy. Their high speeds were achieved by means of 3.15 rear axle gears and a power kit consisting of a high-lift cam, dual four-throat carbs and manifold, and a set of ten-to-one cylinder heads. The kit has a suggested list price of $465. The record cars were equipped with Firestone Super Sports racing tires; there is not a kit for souping up the brakes.

I made ten flat-out laps of the course with Mantz and was able to discuss the cars' performance with the three drivers. The acceleration of these machines surpasses anything in familiar U. S. touring car practice and their road stability at all speeds is exceptionally good. Faulkner's runs were made while strong, gusty winds were blowing across the desert but he reported that they hadn't the least effect on the car's handling.

The one-hour record run was made by Mantz with an engine that had only 75 break-in miles on it at the start. Mantz reported that in over 100 flat-out miles the new engine never missed a beat and that the longer it ran the faster it ran. At the beginning of the run it would not wind beyond 4800 rpm but toward the end was turning 5200. It was Mantz' opinion that the car felt just as solid at 130 as at 30 mph and he proved this to my satisfaction while I was in the car.

On the same day the Mercury speeds were established, the Lincoln Division demonstrated that it is not resting on the laurels won in three Mexican Road Races. The instrument used in this demonstration was a '56 Lincoln Premiere sedan, drastically modified for purely experimental purposes, and *not* with power kit sales in mind. The car's engine was bored and stroked, had solid tappets, special manifolds, camshaft, crankshaft and distributor, and a centrifugal supercharger.

Chuck Stevenson, big silent two-time winner in Mexico drove this car through the NASCAR clocks at 146.599 mph; it was a fantastic sight to see so much machine hurtling at such speed. But that was only the *official* time. During preparatory runs, when only hand-held stopwatch times were being taken, Stevenson got in front of a tailwind and thundered (two straight exhaust pipes) through the traps at just over 157 mph. He told me after the runs that the car could be steered with the fingertips of one hand at its top speed.

Obviously, the most competitive sales era in the auto industry's history is forcing Detroit to return to auto racing, an activity which it carefully shunned for about 15 years. The public show of strength at Ford's Arizona proving ground made it clear to the world that another of the Big Three is firmly entered in the contention to come. — *griff borgeson.*

and snaps back the passengers' heads. The uninitiated take this for real sports-car pickup. It's nothing of the sort, because you don't go anywhere. You just sit there shuddering until the engine manages to scare up enough revs to overcome inertia and get the wheels to turn.

Inside the engine, oil is tossed around in what is known inelegantly but accurately as the "spit-and-hope" lubrication system. Spat out of two jets at the top of the crankcase, the oil flies through space to land in or near two small holes in the crankshaft webs — provided everything is in proper alignment, which is where the hope comes in. The speed of the crankshaft's travel shoots the oil to where it will do the most good, on the same principle as the one that gives you a bellyful of water if you dive off a high board with your mouth open. Like the other Rube Goldbergs that go to make up the Baby Austin, the lubrication system is peculiar, but completely reliable.

Admirers quote a handy legend to the effect that while the Seven's brakes won't necessarily stop the car where you want it to, they will stop it just short of an accident. This is rank superstition. The accepted technique for stopping or even slowing down is to grab the emergency brake and pull as hard as you can, meanwhile putting all possible weight on the footbrake. Austin Seven addicts getting behind the wheel of a car with less character are apt to toss themselves right through the windshield at the first traffic light.

The root of the trouble lies in the undernourished brake drums. Neither the six-inch nor the seven-inch model presents enough braking surface to do the job. When the car left the factory there was an adjustment designed to exert more pressure on the harassed linings, but this was used up the first time the brakes were tightened, which in the case of most of the Sevens now on the road, took place in the days of Rudolf Valentino, knee-length skirts, and "Yes, We Have No Bananas." Nowadays the only way to do something toward improving stopping power is to take up the slack as the brake cables stretch — and stretch — and stretch.

This futile gesture is carried out with clips, and on a really seasoned car the clips are lined up on the cables like sparrows on a telegraph wire.

Do they help? Not much. They must be tightened only with the wheels on full right or left lock, otherwise at the first turn the brakes grab solidly and the car howls to a stop with linings smouldering. Of course, adjusting the brakes on lock and then straightening the wheels again means that most of the adjustment effect disappears. But — well, the Austin Seven has pretty terrible brakes. #

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Renault

(Continued from page 45)

save a lot of work by taking the parts off and laying them out in sequence. Try the other way and find out why.

A replacement manifold is available from Renault and is actually the optional '55 manifold. It is perfectly satisfactory and could be easily modified to a two-carburetor set up but we haven't reached this stage yet.

The new manifold requires two extra studs in the head. The studs that come in the kit have metric threads so you are better off using 5/16" into the head. The muffler installation presents no particular problem. On our own job we used a Hollywood muffler, cut out the holding brackets from the Renault muffler, made brands from 1/16 strap iron to hold the brackets to the muffler, welded up the pipe to go from the manifold to the muffler, and assembled the works. If you are wondering about the tail pipe, we have a consolation for you. The stock Renault doesn't have one either.

Last but not least, comes the carburetor. The stock one is a small Solex without an accelerating pump and has little to recommend it except a very excellent choke system that consists of a secondary carburetor and no obstructions in the carburetor throat. It can be used with the replacement manifold with a small adaptor at considerable loss of power. The factory recommendations call for a 32mm Solex, PBIC, a very fine carburetor indeed and it should be for a $34.00 list price. It can be replaced successfully by a 431 RS Carter carburetor for less than $12.00 and it fits and works perfectly. It has a universal mounting flange which must be centered before installation. The main jet is adjustable from the outside and it is otherwise a stock W.O. Carter.

A distributor setting of five to eight degrees in advance of factory timing is advisable. The factory tappet clearance (set hot) of .008 and .012 can be modified to an even .010 all the way around. For competition a hot .006 setting will improve the performance. The valves are adjusted more easily by making a little slot in an old wrench to fit the flats of the adjusting screws. This completes the engine work,

We made a few modifications to the suspension, like installing a '55 Renault stabilizer bar and heavy duty airplane type shock absorbers borrowed from a Plymouth.

The Renault factory puts out souping up equipment of their own under the brand name of Autobleu. Their kit, for $265, includes a reground cam, a modified cylinder head, a manifold slightly larger than the one we used and the 32 PBIC carburetor. They also offer a larger distributor with a tachometer take-off and a tachometer. The cylinder head they offer has larger valves and ports than the stock head and is sold on an exchange basis. A word to the wise: The intake valve on the old head is exactly the same size as the exhaust valve on the new head. The new head gives remarkable performance considering the fact that the original 7.25:1 compression ratio has been retained. However, the workmanship on the exchange head leaves a lot of room for improvement. The manual spark control we incorporated with the distributor is a great help in starting. Autobleu considers their valve timing top secret.

Top speeds were increased from:

15 miles to 22 miles an hour in 1st.

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With the old manifold and stock setup the engine puts out 21 hp at 4100 rpm. With the new manifold the power is boosted to 28 hp at 4500 rpm, while with the complete Autobleu kit 35 hp at 5500 rpm is claimed.

With an extractor type tuned exhaust and larger carburetor, a compressor and a strong tailwind — oh well, a fellow can dream, can't he? #

VW

(Continued from page 49)

tates of low weight and compactness, chose a radius-type cam follower. This design is excellent for use with the hollow-flank or constant-acceleration cam which happens to be an Iskenderian specialty. Using the same principles applied in their 404 and Offenhauser grinds, the VW cam lift was increased and the rate of opening and closing accelerated. The popular road grind has a lift of .318-in. at the cam. The opening rate is such that at top dead center the valve is already .060-in. off the seat and is fully open at 90 degrees after TDC, when the piston has reached maximum velocity. This in itself is a tremendous step in overcoming the disadvantages of the VW's small valves and restricted porting.

The inevitable loss of power at low speeds associated with high-performance valve timing has been kept to a minimum here because the stock VW is so "under-cammed" that the low-speed characteristics of the modified camshaft are almost within the limits of "normal stock" practices. A smooth idle is possible and if anything is lost "at the bottom" the increase in compression ratio effectively offsets it. The drawings show the various grinds compared to stock VW timing. Naturally, increased overlap is exploited as a means of improving breathing efficiency. But to take full advantage of this modification, a well-engineered exhaust system is essential, and that's the third important part of the combination.

Actually, it's the most important single factor and, by itself, it makes a big improvement in performance. It is interesting that even the factory relented on this point after reportedly being against it earlier, and has fitted dual exhausts to its latest models. But most tune-up experts continue to swear by the excellently-engineered Abarth exhaust system for all VW's.

The stock VW intake manifold's extreme length and small diameter exaggerates all the classic ills of carburetion. Pulsation, wall-friction, uncontrollable column inertia are only a few of the maladies that deliver unbalanced volumes and mixtures to the VW's cylinders. Some owners are content to settle for the limited top speed of the single-carb modified unit, feeling that the extra expense of fitting dual carbs is not worthwhile for only a few mph gain in top speed and very little improvement in acceleration. But the marked reluctance of the engine to rev freely with the single *vergaser* actually takes a lot out of overall performance figures. Higher shifting points reached sooner in second and third gears make this final change very desirable.

It's true that the fitting of two carbs, even with their short manifolds, will not completely cure all the VW's breathing problems, but it does increase the venturi or carburetor throat area. The importance of this at high revs becomes clearer when it is realized that throttle action is simply a method of varying the effective throat area. For the dual-carburetor conversion, two stock Solex 28PCI carbs with stock jets may be used, which involves the fabrication of special manifolds and throttle linkage. A complete kit containing two Amal-type carbs and all necessary incidentals, is available from Competition Chemicals, Iowa Falls, Iowa, for $80.

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bination treatment" will naturally vary from shop to shop but should cost in the region of $300, including dual carbs. What you get for this sum is a horsepower increase ranging from 40 to 50 percent, with a proportional, gratifying improvement in performance.

Equal or better gains can be made by the simple, bolt-on technique of adding a supercharger. In fact, with high boost pressures, the meek VW becomes a Chevrolet-hunting tiger!

Supercharging has often been maligned in the automotive world but, like the two-stroke cycle, has fascinated some of the world's ablest engineers. The principles of supercharging are simple; their application is complex.

The function of a supercharger is to deliver to the cylinder more fuel-air mixture by weight than is possible by normal atmospheric induction. In simpler terms, the fuel-air mixture is compressed, increasing the weight for any given volume, and then is delivered to the cylinder in this state. Since an internal combustion engine's power potential depends on the amount of fuel-air mixture by weight that it can burn in a given time, supercharging obviously is a very direct way to improve performance.

Also, supercharging is a simple, unsubtle method of over-riding defects, intentional or otherwise, in atmospheric induction systems. It works like a pulmotor: the patient and its response to this therapy is dramatic.

The problems of developing a supercharger perfectly suited to the VW's requirements have been solved by several qualified manufacturers. The prices vary and the results vary, but all are equally simple to install.

The maximum boost with the Judson unit is about 6.5 lbs., which provides a hp boost of about 50 percent. The added urge with this low boost pressure is readily explainable. A really efficient ohv engine with its highly developed induction system would register little response to blowing. But the VW, having been deliberately throttled at the valves, shows great improvement. It's worth keeping in mind here that even with an increased output of 50 percent the supercharged VW still is producing less bhp than most other *stock* engines of similar displacement.

The Judson blower gives the VW about the same performance as the internal "combination" treatment. It costs $159.50, installed.

Another popular answer to blowing the VW is the Roots-type, U.S.-made Pepco unit. Like the Judson, it's bolted directly to the stock VW mani-

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fold and is driven off the crankshaft by twin belts. Like the Judson, it utilizes the stock carb, but its claimed boost comes as a distinct shock: 10 lbs. After a little reflection this pressure doesn't seem excessive. Remember, we're still dealing with mixture weight delivered and burned. Ten lbs. maintained against the recalcitrant VW manifolding will result in considerably less weight delivered to the cylinders in a given time than would be the case with a free-flowing induction system.

The Pepco Roots blower suffers slightly from mechanical inefficiency at low rotor speeds. This is due to the slip-loss or leakage past the necessary clearances between the rotors and the casing. However, this forms a diminishing fraction of the total volume of air pumped as speeds go up. Overall efficiency with this blower is very high. The results are profoundly, overwhelmingly apparent. In fact, they're shatteringly convincing.

Pepco superchargers are made in Dayton, Ohio. They and the Judson units are available on the West Coast through Bill Corey's Empire Motors, Pasadena, Calif. The persuasive Pepco supercharger, with all necessary components, sells for $199.50.

I remember the days when superchargers on American race cars were accurately referred to as vacuum cleaners. This was because they sucked up everything in their path that wasn't nailed down. When you buy a blower you want it to last as long as your engine. The suppliers have skimped in the air-cleaner department. But that's something you can correct yourself for a buck or two. What counts the most is that means actually have been found to confound even the most careful plans of the VW factory. #

Corvette

(Continued from page 53)

supposed to be available as optional equipment.

Tire rolling resistance was another vital factor in the top speeds made by the Daytona Corvettes. They would have been lucky to reach 135 mph with the factory-equipped tires. Few of us realize that it requires about 160 hp to roll these tires at 150 mph — under the weight of the Corvette and inflated to 28 lbs./sq. in. Rolling resistance is caused by the violent flexing and stretching of the tire casing and tread layer under rolling and centrifugal forces. We can reduce it by increasing inflation pressure, using stiffer 6-ply casings with a steep cord weave angle, and with a lighter, thinner tread layer. The special Firestone Bonneville tires have the lowest rolling resistance factor of anything available in this country, and they compare favorably with the European super-speed types for record cars (Dunlop, etc.). They have only a fraction of the drag of regular passenger tires, and seem to be substantially below the conventional full-tread racing tires like the Firestone Super Sports 170 and Goodyear models. Most of the really fast cars at Daytona, including the Corvettes, were on Bonneville rubber for their top-end runs, running inflation pressures anywhere from 40 to 65 lbs.

Add up all these drag-reducing gimmicks — stripped windshield and competition screen, cockpit cover, partially masked grille opening, headrest fin, Bonneville tires at 50 lbs. pressure — and it would take roughly 190 hp at the clutch to move the competition Corvette 150 mph in still air on pavement. So you see, things begin to fall into place. The absolute top speed potential of this combination on pavement, using the 3.27:1 rear-end ratio, is definitely *over 160 mph.* Duntov clocked 163 mph at 6300 rpm on the Arizona test track. An honest 245 hp should account for this — which appears to be well within the capabilities of the engine in stock form, with options.

The best two-way average on the beach was 150.53 mph. Duntov feels the true potential here is over 155, given excellent beach and wind conditions. Rolling resistance on the sand is definitely higher than on hard pavement — and, as beach conditions deteriorate, resistance goes up and traction comes down. Also, wind is a problem at Daytona. *Any* kind of wind component parallel to the course acts to chop down the two-way average; the wind holds you back more on the upwind run than it boosts you downwind. Coast-wise winds of 35 mph are not unusual at Daytona.

Conditions weren't perfect on any of the runs. On his 150 mph runs prior to Speed Week Duntov had little wind, but only a fair beach; he was getting five percent wheel-spin. On Fitch's official two-way runs with the production Corvette during Speed Week the beach was good, but there was a 20 mph coast-wise wind. He turned 155 mph downwind, but the two-way average came out to 145.54. Duntov averaged 147.3 mph in the modified class that day. He figures if he could have switched to a 3.08:1 axle ratio for the downwind run he could have increased his speed from 156 mph to more than 160. At any rate, it appears that the true top speed *potential* of the competition Corvette on Daytona Beach is a good five or 6 percent below the speed on hard, smooth pavement. That should answer some burning questions!

I have listed a set of road test figures which I obtained personally on a friend's strictly "showroom" '56 Corvette . . . then for comparison I've *calculated* the corresponding figures for the Sebring Corvette, using slide rule, graph paper, and a planimeter (area measuring instrument for graphical analysis). I think I hit the true performance of the Sebring cars pretty close with this method, by using all available technical data on the cars and carefully estimating the "unknowns."

Incidentally, the calculations on this car are based on a gross weight of 2900 lbs., 3.55:1 axle ratio, and a shift point of 6500 rpm in the gears. (This was used by Duntov on his standing mile runs, but might be a little high for a long race.) The showroom Corvette had stick shift, 3.55:1 axle, but not the Duntov cam. It seemed to run well in all rpm ranges, but there was no special tune-up for the test. It had about 700 miles on the odometer.

Here are the figures on the two cars for comparison:

	Sebring	*Huntington*	*SCI Test*
0-30 mph. . . .	3.2 secs.	3.2 secs.	3.4 secs.
0-60 . . .	6.3 secs.	7.5 secs.	7.5 secs.
0-80 . . .	9.6 secs.	12.4 secs.	12.5 secs.
0-100 . . .	15.1 secs.	21.2 secs.	19.3 secs.
Standing ¼-mile . . .	14.9 secs.	16.0 secs.	15.9 secs.
Speed at ¼ . . .	99 mph	89 mph	91.0 mph
Top speed . . .	Approx. 148 mph	(top speed) 121 mph	120.0 mph

And there you are. There's a pretty big difference between the performance of our production-line Corvette and the Sebring job, but obviously both of them can hold their own in pretty quick company. The showroom job would have strictly no trouble with its arch-rival, the showroom T'bird — and the Sebring cars, I think, might even raise a few eyebrows on the California drag strips.

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